NEW YORK
New York City

Ten year capital needs assessment, 1984-1993 : New York City Transit Authority.

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NEW YORK CITY TRANSIT AUTHORITY

TEN YEAR CAPITAL NEEDS ASSESSMENT
1984-1993

DANIEL T. SCANNELL
ACTING PRESIDENT

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November 28,1983

TO THE BOARD OF DIRECTORS

Ladies and Gentlemen:

I am pleased to submit this revision to the MTA Staff Report of Capital Revitalization for the 1980's and Beyond, as requested by the MTA Capital Program Review Board. This document outlines the projected capital funding needs of the Transit Authority for the period 1984 to 1993.

Sincerely,

Daniel T Scannell

Daniel T. Scannell
Acting President

New York City

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NEW YORK CITY TRANSIT AUTHORITY

TEN YEAR CAPITAL NEEDS ASSESSMENT

1984 - 1993

1983

66 p.

Daniel T. Scannell
Acting President

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NEW YORK
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INTRODUCTION AND SUMMARY

The capital assets of the New York City Transit Authority are vast. The system encompasses 707 miles of mainline track and supporting infrastructure, 465 passenger stations, 6300 subway cars, 4000 buses, and extensive support facilities, including four major repair shops, 13 subway car barns, 20 bus depots, and 23 storage yards that include 122 miles of track.

Historically, capital investment levels to support and replenish the assets of the Transit Authority have been inadequate, resulting in substantial deterioration of plant and equipment over time. In 1980, the capital needs of the Transit Authority were estimated at more than $12 billion (1980 dollars) over a ten year period. The Five Year Capital Program, initiated in 1982, constituted the first phase of a massive program to restore the transit system to a state of good repair. That program provided sufficient funds to increase average annual capital investments (in real terms) by almost four times the rate of investment during the previous decade (excluding funds for New Routes).

Today, following revisions and increases in available resources, principally as a result of the Surface Transportation Assistance Act of 1982, the Five Year Capital Program (August 25, 1983) provides $6.5 billion for the period 1982 through 1986 to rehabilitate and replace the Transit Authority's capital assets. In constant 1984 dollars, the current program amounts to $6.9 billion. (Unless otherwise noted, costs are expressed in 1984 dollars throughout this report.) Nevertheless, substantial additional investment in the capital assets of the Transit Authority will be required during the next ten years and beyond to continue this process and to protect against future deterioration.

This document outlines the estimated capital requirements of the Transit Authority over the period 1984 through 1993. Cost estimates of construction and procurement activities necessary to bring the system to a state of good repair and to implement new initiatives are based on experience to date. The estimates for an ongoing normal replacement program -- also included in this report -- are based on the useful lives of various system elements and estimated replacement costs.

The capital needs identified here reflect preliminary projections. These estimates are based on the best available information regarding the current condition of capital assets and anticipated future conditions given planned investment levels. These projections are not constrained by assumptions regarding available resources, but instead reflect the Authority's goal to achieve a state of good repair as rapidly as possible given the system's capacity to absorb the needed investments. As more information becomes available and ongoing investment analysis is completed, future revisions in these projections may be warranted. These estimates, nevertheless, provide a good approximation of the magnitude of the Authority's future capital funding needs.

SUMMARY OF TEN YEAR CAPITAL NEEDS

The New York City Transit Authority's capital investment needs for the next ten years total an estimated \$11.8 billion[1], assuming the current system configuration. This level of investment would bring most of the transit system to a state of good repair, establish an ongoing program of normal replacement and reinvestment in the Authority's capital assets, and fund a number of new program initiatives. In addition, the Authority has identified another \$4 to \$5 billion in capital investment needs which are not included in this estimate. The bulk of these additional needs -- \$4 billion -- would be necessary to bring the entire transit system to a state of good repair by 1993. Up to another \$1 billion would be required to fund new route construction. In recognition of various operating constraints that limit the Authority's ability to undertake this capital work, these additional investment requirements are excluded from the total estimated funding needs outlined in this document.

A portion of the Authority's ten year capital needs will be funded under the balance of the Five Year Capital Program -- \$2.7 billion over the period 1984 through 1986. Additional funding necessary to support the Authority's ten year investment program will total \$9.1 billion. The ten year capital funding needs projected for the Transit Authority are summarized in Table 1.

TABLE 1
SUMMARY OF NEW YORK CITY TRANSIT AUTHORITY 10 YEAR CAPITAL NEEDS 1984-1993
($ millions)

	1984-88	1989-93	Total
Achieve State of Good Repair	\$4,299	\$2,968	\$7,267
Normal Replacement Cycle	665	2,756	3,421
New Initiatives	521	591	1,112
Total	\$5,485	\$6,315	\$11,800

NOTE: The New Initiatives category does not include funding for New Routes. Current cost estimates for the alternatives being considered range up to \$925 million (See New Routes, Category T-15).

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[1] Given alternative inflation assumptions, the ten year needs of the Transit Authority total:
- \$15 billion assuming a 5% annual inflation rate;
- \$17 billion assuming a 7.5% annual inflation rate; and
- \$19 billion assuming a 10% annual inflation rate.

See Appendix A.

State of Good Repair

A large portion of the Authority's ten year capital needs is required to bring most transit system elements to a state of good repair. (A state of good repair is defined here as eliminating all overage components and ensuring that the physical plant of the system is adequate to provide the required level of service.) About $7.3 billion or 62 % of the total ten year capital needs will be dedicated to achieving a state of good repair as rapidly as possible. Most of these funds -- $4.3 billion -- will be committed during the five year period 1984 through 1988.

As a result of this expenditure program, a large portion of the transit system will reach a state of good repair by 1990. The Authority's rolling stock (rapid transit cars, transit buses, and service vehicles) will achieve a state of good repair by 1990 at the latest, as will most of the Authority's maintenance and repair facilities (specifically, the car maintenance shops and barns and bus depots). In addition, all deteriorated track and switches will be eliminated from the system by 1990.

Most of the remaining capital assets will reach a state of good repair by the end of the ten year period. All line structures, power facilities, and storage yards will achieve a state of good repair by 1993, as will most line equipment. Additionally, by 1993, 75% of all rapid transit riders will pass through passenger stations that have been modernized.

Four system components will not achieve a state of good repair under this program, however. Overaged portions of the tunnel lighting system and signal system will remain beyond 1993. In addition, almost half of the 465 passenger stations will not undergo comprehensive modernizations by 1993. Moreover, approximately 150 miles of obsolete track and switches will remain in use throughout the system at the end of this ten year period. (These track components are in a state of good repair but are considered technologically obsolete.) Similarly, overaged portions of the track and signal systems of SIRTOA will remain at the end of 1993. Operational considerations and competing priorities limit the Authority's ability to rehabilitate all these elements by 1993. Bringing all these elements to a state of good repair would require an additional $4 billion not included in this needs assessment.

Normal Capital Replacement and Reinvestment

During the ten year period, 1984 - 1993, a program of ongoing replacement and reinvestment will be established for most of the Authority's capital assets at an estimated cost of $3.4 billion. This level of reinvestment and replacement will be necessary to protect the investments made under the current Five Year Capital Program and to maintain the Authority's capital assets in a state of good repair.

Most of the funding for normal replacement and reinvestment will be required during the final five years of the ten year period as major components of the transit system achieve a state of good repair. Increasingly, the emphasis of this ten year investment program will shift from achieving a state of good repair through major expenditures for capital rehabilitation to establishing and maintaining a normal replacement and reinvestment cycle. Accordingly, all capital investments by the Transit Authority will eventually be directed at normal reinvestment or replacement and new program initiatives. Current estimates indicate capital funding requirements to sustain a program of normal replacement and reinvestment over the long run (after all components of the system attain a state of good repair) will total $4 billion every five years -- an average rate of $800 million annually.

During the ten year period 1984 - 1993, a program of normal replacement and reinvestment will be instituted for elements that reach a state of good repair. The estimated investment required to sustain a program of normal replacement for rolling stock (transit cars, buses, and service vehicles) will total $1.3 billion over the ten year period, while the normal replacement of track will require an additional $700 million over that period. Together, these program categories account for 58% of the funding needs identified for normal replacement over the ten year period.

New Initiatives and New Routes

A modest program of new initiatives will require $1.1 billion over the ten year period. Some $713 million of these funds will be necessary to support new program initiatives in stations ($320 million), yards ($265 million), and line structures ($128 million). The remaining $399 million will be used to support new initiatives in several program categories, specifically car overhaul, buses, track, barns and shops, depots and information systems.

Additional funding of up to $925 million may be required to support construction of new subway routes in Queens, for which a number of construction alternatives are currently under consideration. This potential funding requirement is not included in this needs assessment. The magnitude of the funds required to rehabilitate the existing system makes the consideration of this initiative impractical at this time.

Ten Year Capital Needs in a Historical Context

The ten year capital needs projected for the Transit Authority continues the rate of capital investment established under the current Five Year Capital Program. The allocation of capital needs across program categories differs substantially, however, from that contained in the present program. Substantial reallocation of capital resources will therefore be required over the next ten years. The Executive Capital Budget for January 1984 - June 1985 recognizes this need to reallocate funds across program categories and takes a first step. Table 2 summarizes (by program category) the allocation of funds under the current Five Year Capital Program and the projected capital needs for the ten year period 1984 to 1993.

Capital investments by the Authority during the decade prior to 1982 were strikingly meager. Total capital investment by the Transit Authority was $1.3 billion (excluding funds for New Routes) during the five year period from 1972 through 1976. Similarly, only $1.7 billion in capital funds was committed during the period 1977 through 1981. This level of investment contrasts sharply with the $6.7 billion (excluding funds for New Routes) provided under the Five Year Capital Program. Similarly, the $11.8 billion in capital needs identified for the period 1984 through 1993 is substantially higher than pre-1982 investment levels. (See Chart 1).

The following sections summarize the ten year capital needs in light of historical investment levels for each of three major program areas -- Rapid Transit, Right of Way, and Surface Transportation. Descriptions of the ten year capital needs for each specific program (or T-category) follow these sections and outline the basis of the estimated capital needs.

TABLE 2
COMPARISON OF FIVE YEAR CAPITAL PROGRAM AND TEN YEAR NEEDS
($ millions)

	Five Year Capital Program	Ten Year Capital Needs		
	1982-86[1]	1984-88	1989-93	Total
T-01 Cars-New	$1,768	$ 101	$ 764	$ 864
T-02 Cars-Rebuilt/Rehab	633	645	413	1,058
T-03 Buses	336	301	356	657
T-04 Passenger Stations	569	415	784	1,199
T-05 Track	389	659	479	1,138
T-06 Line Equipment	141	360	575	935
T-07 Line Structures	241	564	769	1,333
T-08 Signals and Comm.	447	506	595	1,101
T-09 Power	304	332	200	532
T-10 Shops	485	363	165	528
T-11 Yards	430	411	513	924
T-12 Depots	432	380	211	591
T-13 Service Vehicles	71	37	52	79
T-14 Security[2]	23	-0-	-0-	-0-
T-15 New Routes[3]	204	-0-	925	925
T-16 Other Programs[4]	215	78	70	148
Subtotal	$6,688	$5,152	$5,936	$11,088
SIRTOA	34	72	78	150
Emergency/Contingency	143	261	301	562
Total	$6,865	$5,485	$6,315	$11,800

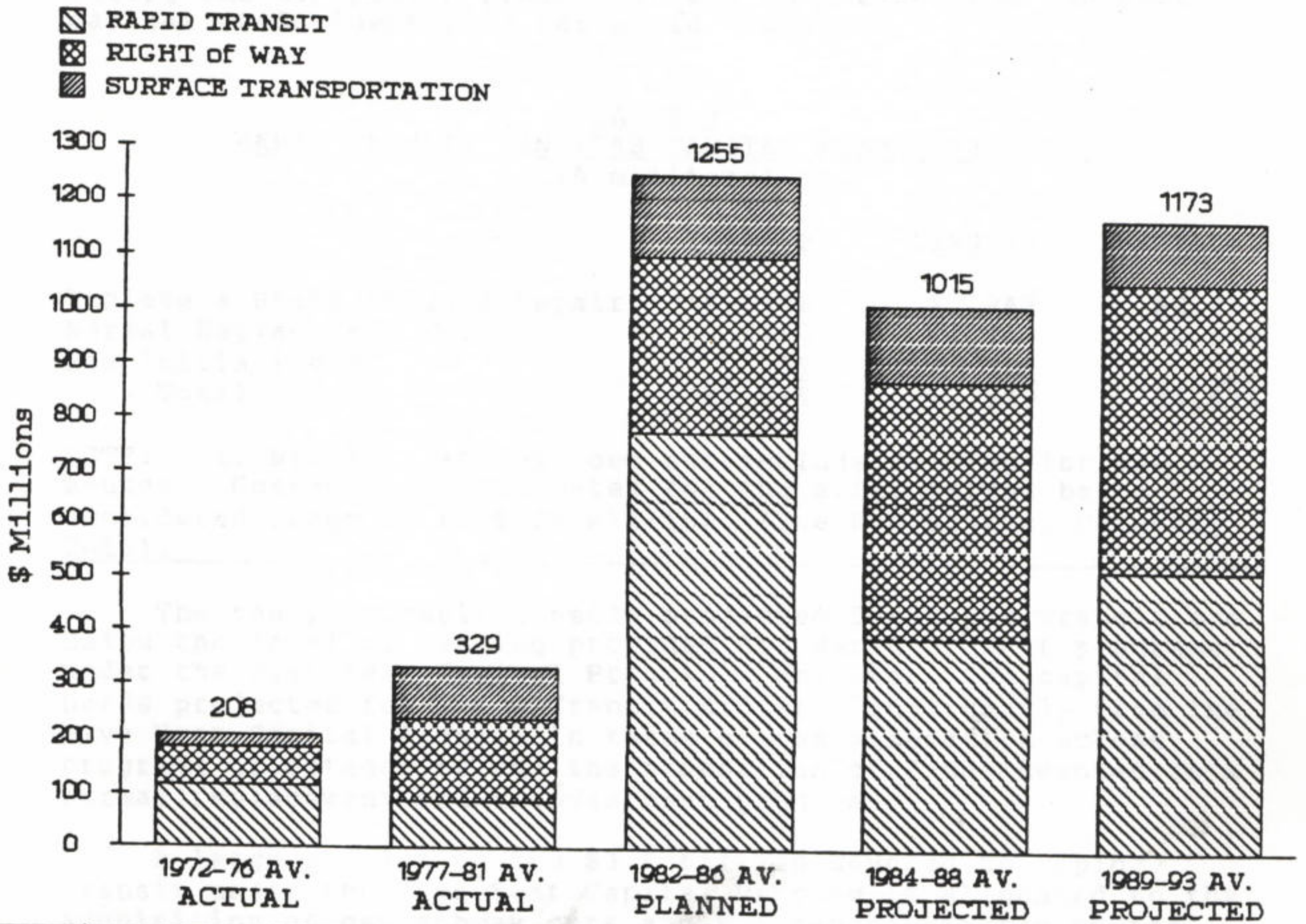
NOTES: 1. The figures reflect the Five Year Capital Program, August 1983, in 1984 dollars.

2. The projects under the Security category consist primarily of passenger station security improvements. Security projects during the ten year period have been incorporated into other categories reflecting the location or facility where the work is scheduled.

3. Funds for New Routes are not included for the ten year period. Current cost estimates for various alternatives range up to $925 million (See New Routes, Category T-15).

4. Other programs include the Procurement and Distribution Department, Systems and Information Management Department and New Technology Investigation and Testing.

CHART 1-NYCTA AVERAGE ANNUAL CAPITAL COMMITMENTS
(IN MILLIONS-1984 DOLLARS)



NOTES:

RAPID TRANSIT INCLUDES SUBWAY CARS, PASSENGER STATIONS, CAR MAINTENANCE BARNS AND SHOPS, AND STORAGE YARDS. RIGHT OF WAY INCLUDES TRACK, LINE EQUIPMENT, LINE STRUCTURES, SIGNALS AND COMMUNICATIONS, POWER AND SERVICE VEHICLES. SURFACE TRANSPORTATION INCLUDES BUSES AND DEPOTS. NEW ROUTES, OTHER PROGRAMS, SIRTOA, AND EMERGENCY & CONTINGENCY ITEMS ARE NOT INCLUDED.

RAPID TRANSIT

During the period 1984 to 1993, $4.6 billion in capital funds will be required to rehabilitate and replace subway cars, passenger stations, and the facilities that store and service subway cars. More than a third of these funds -- about $1.7 billion -- will be devoted to bringing passenger stations, storage yards, and car shops and barns to a state of good repair by 1993. Another $600 million will be required to bring the fleet to a state of good repair through the Car Overhaul Program and other car projects, while an additional $1.3 billion will be required to continue upgrading the fleet of subway cars through a program of normal replacement and rehabilitation. In addition, an estimated $712 million will be required for new program initiatives in the Rapid Transit area during the ten year period. Table 3 summarizes the ten year capital needs identified for Rapid Transit.

TABLE 3
RAPID TRANSIT TEN YEAR CAPITAL NEEDS 1984-1993
($ millions)

	1984-88	1989-93	Total
Achieve a State of Good Repair	$1,386	$ 847	$2,233
Normal Replacement Cycle	160	1,469	1,629
New Initiatives[1]	389	323	712
Total	$1,935	$2,639	$4,574

NOTE: 1. New Initiatives does not include funding for New Routes. Current cost estimates for the alternatives being considered range up to $925 million. (See New Routes, Category T-15).

The ten year capital needs projected for Rapid Transit are below the level of funding provided for Rapid Transit programs under the Five Year Capital Program. Moreover, the capital needs projected for Rapid Transit differ significantly from the Five Year Capital Program in terms of the allocation across programs or categories and the proportion of funds devoted to a normal replacement and reinvestment program.

A large portion of the $3.9 billion devoted to Rapid Transit under the Five Year Capital Program is allocated to the acquisition of new subway cars and the rehabilitation of the existing car fleet. More than $2.4 billion is allocated for this purpose under the Five Year Capital Program. By comparison, the capital needs for subway car acquisition and rehabilitation are estimated at $1.9 billion over the ten year period -- less than half the rate of commitment contained in the Five Year Capital Program. This reduction in funding needs

for subway cars reflects the fact that the car fleet will reach a state of good repair by 1988 as a result of investments in the car fleet early in the Five Year Capital Program. The ten year needs reflect the funding required to reinvest and maintain this state of good repair.

By comparison, the projected ten year capital needs for passenger stations is comparable to the rate of expenditure for stations under the Five Year Capital Program, which allocates $569 million for station improvements and modernization. The projected ten year needs for passenger stations are estimated at $1.2 billion.

The projected ten year needs for storage yards and car maintenance shops and barns are significantly less -- by about 20% -- than the rate of investment contained in the Five Year Capital Program. Moreover, a shift in program emphasis will occur in the yard program from yard expansions (or new initiatives) under the Five Year Capital Program to yard rehabilitation (or state of good repair) over the next ten years.

RIGHT OF WAY

The Transit Authority will require $5.0 billion over the next ten years to rehabilitate and replace its Right of Way. This program category consists of track, line equipment, underground and open air structures, signals and communication equipment, and power facilities, as well as the service vehicles necessary to maintain the Right of Way.

A large portion of the projected capital needs -- about $3.8 billion -- will be required to bring the right of way components to a state of good repair. This level of investment will include elimination of deteriorated track and track components ($381 million), rehabilitation of elevated structures ($320 million), a 43% reduction in the quantity of overaged signals ($914 million) and completion of the power modernization program ($504 million). By 1993, the only components of the right of way where a state of good repair will not be achieved are tunnel lighting and signals -- both of which will be completely upgraded by 2003.

A total of $1.1 billion will be required to establish a normal reinvestment and replacement program for right of way facilities and components. Over 80% of this total will support normal replacement of track and track components and power distribution facilities. Additional funding will be required for normal replacement investments in structures, communications, and power substation enclosures.

A modest program of new initiatives is proposed -- $179 million -- primarily to eliminate the grade crossing at Rogers Junction on the Brooklyn IRT service and to install new crossovers at key locations throughout the system. These new initiatives will improve the quality of service and permit greater operational flexibility in the Rapid Transit system.

Table 4 summarizes the ten year capital needs identified for Right of Way programs.

TABLE 4
RIGHT OF WAY TEN YEAR CAPITAL NEEDS 1984-1993
($ millions)

	1984-88	1989-93	Total
Achieve State of Good Repair	$2,005	$1,805	$3,810
Normal Replacement Cycle	395	655	1,050
New Initiatives	21	158	179
Total	$2,421	$2,618	$5,039

The ten year capital needs projected for Right of Way programs are significantly higher than the rate of funding provided for Right of Way programs under the Five Year Capital Program. The Five Year Capital Program provides $1.5 billion for Right of Way. By comparison, the ten year capital needs for Right of Way programs are estimated at $5.0 billion -- about 67 percent higher than the rate of investment under the Five Year Capital Program.

This increase in identified capital needs for Right of Way programs reflects additional information and more refined assessments concerning the current condition of Right of Way equipment and facilities. Ongoing condition surveys of track, line structures, and line equipment will likely result in further revisions to these identified needs.

SURFACE TRANSPORTATION

During the period 1984 to 1993, $1.2 billion will be required to rehabilitate and replace transit buses and bus depots. More than half these funds -- about $697 million -- will be devoted to bringing the bus fleet and bus depots to a state of good repair by 1993. An estimated $457 million will be required to maintain this plant and equipment through a program of normal replacement and rehabilitation. Additionally, some $94 million will be required to support new program initiatives in the surface transportation area.

Table 5 summarizes the ten year capital needs identified for the bus system.

TABLE 5
SURFACE TRANSPORTATION TEN YEAR CAPITAL NEEDS
($ millions)

	1984-88	1989-93	Total
Achieve State of Good Repair	$ 598	$ 99	$ 697
Normal Replacement Cycle	24	433	457
New Initiatives	59	35	94
Total	$ 681	$ 567	$1,248

The ten year capital needs projected for Surface Transportation reflect a lower rate of investment than provided under the Five Year Capital Program. The projected capital needs also differ in that most of the expenditures funded under the Five Year Capital Program are required to bring bus facilities and equipment to a state of good repair. By comparision, more than a third of the projected ten year capital needs for Surface will be required to maintain a normal replacement and reinvestment program. Such expenditures will be necessary to protect the Authority's five year program of investment.

A large portion of the $768 million devoted to Surface Transportation under the Five Year Capital Program is allocated for the rehabilitation and expansion of the Authority's bus depot capacity, with more than $430 million allocated for this purpose. By comparison, the capital needs for depot rehabilitation and expansion are estimated at $427 million over the ten year period -- half the rate of commitment contained in the Five Year Capital Program. This reduction in identified funding needs for bus depot rehabilitation and expansion reflects the fact that a substantial number of the depots will be rehabilitated under the Five Year Capital Program. Accordingly, an estimated $114 million will be required during the ten year period to establish an ongoing normal replacement and reinvestment program for bus depots.

The projected ten year capital needs for buses is comparable to the rate of expenditure for buses under the Five Year Capital Program. The Five Capital Program provides $336 million for the bus procurement program while the projected ten year needs for this program total $663 million.

PART II

TEN YEAR CAPITAL NEEDS

BY

PROGRAM CATEGORY

NEW CAR PROCUREMENT
(Category T-1)

The New York City Transit Authority currently operates a fleet of 6,300 subway cars. These cars provide over two million yearly train trips for the nearly one billion passengers. The average car travels between 42,000 and 45,000 revenue miles per year. The oldest cars in the system, the R10, cost $77,319 per car (nominal dollars) in 1948. The newest cars, the R68, cost $1,107,000 per car in 1982 (nominal dollars).

During the ten year period 1972 through 1981, the Authority committed $721 million for new subway car procurement. These funds were used to purchase the 754 cars of the R46 class in 1975. No additional cars were purchased by the Authority until 1982, when $1,768 million was committed for the purchase of 1,375 subway cars, the R62 and R68 classes. It is anticipated that during the ten year period 1984 through 1993, $865 million in capital funds will be needed to purchase 687 Rapid Transit subway cars. This is based on the assumption that cars will be replaced on roughly a 35 year cycle. To the extent that analysis suggests a different and more economical purchase cycle, anticipated capital needs will be adjusted.

TABLE 6
NEW CAR PROCUREMENT
TEN YEAR CAPITAL NEEDS 1984-1993
($ millions)

	1984-88	1989-93	Total
Achieve a State of Good Repair	$-0-	$-0-	$-0-
Normal Replacement Cycle	101	764	865
New Initiatives	-0-	-0-	-0-
Total	$101	$764	$865

State of Good Repair

The Rapid Transit fleet will achieve a state of good repair by 1988 through a reduction in the average fleet age and through improvements in fleet reliability. The 1982 purchase of 1,375 new cars will permit the retirement of 1,724 older cars (some over 36 years old) and will reduce the fleet size from 6,300 cars to just under 6,000 cars. In the IND/BMT, new 75 foot cars with eight cars to each train will replace older 60 foot cars with ten cars to each train. In addition, the expected improvements in fleet reliability will allow a reduction in the spare fleet to 19% of peak hour needs from the current 23%.

The average fleet age in the IRT Division will drop from 23 years to 14 years in 1987, when the delivery of the last of the new R62 cars is expected. In the IND/BMT, the average age will remain approximately 17 years.

Fleet performance as measured by Mean Distance Between Failure (MDBF) will improve by more than 100% from 7,100 miles in 1982 to 15,000 miles in 1987. Part of this improvement will stem from the purchase of new cars which, after break-in, are expected to have an MDBF of 30,000 miles. The cars being replaced currently have an MDBF of less than 5,000 miles. The overhaul program and improvements to the inspection and repair facilities will also contribute to the improvement in fleet performance. (See T-2 Car Overhaul and T-10 Shops.)

Normal Replacement Cycle

In 1987, the IRT fleet will contain 2,553 cars. Assuming no significant changes in service levels, 2,150 cars will be needed to meet peak demands with 403 cars or 19% of the peak fleet as spares. Assuming a 35 year life, 73 new cars would be needed each year to replace 73 old cars after 35 years of service. This replacement would maintain the average age of the IRT fleet at approximately 17 years. (Assuming a 30 year life, 85 new IRT cars would be needed each year and the average age would be 15 years.) Using the 35 year life assumption, 219 new IRT cars will be purchased during the 1991 through 1993 period, beginning with 73 in 1991. Assuming a per car cost based on the R62 cars of $1.18 million, the capital investment required is $258 million. Alternatively, given a 30 year life, 425 cars will be necessary at a cost of $502 million. (See Table 7.)

In 1987, the IND/BMT fleet will contain 3,409 cars. This fleet will be sufficient to meet present service levels as well as the initiation of the two completed portions of new routes in Queens -- the Archer Avenue and East 63 Street lines. Once plans for the complete use of these new routes are finalized, additional cars may be needed. Approximately 2,843 cars will be needed for IND/BMT peak service with 566 cars or 20% of the peak fleet as spares. Based on a 35 year life, 98 new cars (of comparable capacity) would be needed each year. Since the present 60 foot cars will be replaced by 75 foot cars, only 78 cars will be needed to maintain the same capacity level, while placing the IND/BMT fleet on a normal replacement cycle.

(Assuming a 30 year life, 91 new cars would be needed each year.) Based on the 35 year life assumption, the purchase of 468 new IND/BMT cars will be necessary during the 1988-1993 period, beginning with 78 cars in 1988. Assuming a per car cost similar to the R68 cars of $1.30 million, the total capital investment required for the IND/BMT fleet is $607 million over the six year period from 1988 through 1993. (If cars are replaced after 30 years, 546 cars will be necessary at a cost of $708 million.)

Table 7 shows a normal replacement and retirement schedule based solely on the assumed life of a subway car (both 30 or 35 year lives are shown). Actual new car series purchases will be based on an analysis that compares the operating costs, capital costs, and service reliability of existing cars with new car replacements.

TABLE 7
SUBWAY CAR PROCUREMENT AND DELIVERY
1984 - 1993

IRT Division	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	Total New Cars[1]
New Car Delivery (R-62)	275	142	340	383	--	--	--	--	--	--	1,140
Old Car Retirement	164	191	257	469	106	--	--	--	--	--	--
Fleet Size[3]	2,711	2,662	2,745	2,659	2,553	2,553	2,553	2,553	2,553	2,553	--
Average Age (Years)	21.8	21.1	18.6	14.7	14.9	15.9	16.9	17.9	18.9	19.9	--
Additional Car Purchases											
- 35 Year Life	--	--	--	--	--	--	--	73	73	73	219
Average Age	21.8	21.1	18.6	14.7	14.9	15.9	16.9	16.9	17.1	17.1	--
- 30 Year Life	--	--	--	--	--	85	85	85	85	85	425
Average Age	21.8	21.1	18.6	14.7	14.9	15.9	15.9	15.9	15.9	15.9	--
IND/BMT Division											
New Car Delivery (R-68)	--	140	85	--	--	--	--	--	--	--	225
Old Car Retirement[2]	102	135	128	47	23	--	--	--	--	--	--
Fleet Size[3]	3,494	3,499	3,456	3,432	3,409	3,409	3,409	3,409	3,409	3,409	
Average Age	17.7	17.9	17.0	17.9	18.8	19.8	20.8	21.8	22.8	23.9	
Additional Car Purchases											
- 35 Year Life	--	--	--	--	78	78	78	78	78	78	468
Average Age	17.7	17.9	17.0	17.9	17.5	17.5	17.5	17.5	17.5	17.5	
- 30 Year Life	--	--	--	--	91	91	91	91	91	91	546
Average Age	17.7	17.9	17.0	17.9	17.0	16.5	15.5	15.5	15.5	15.5	
Total System											
New Car Delivery(R62/68)	275	282	425	383	--	--	--	--	--	--	1,365
Old Car Retirement[2]	266	326	385	516	129	--	--	--	--	--	--
Fleet Size[3]	6,205	6,161	6,201	6,091	5,962	5,962	5,962	5,962	5,962	5,962	
Average Age	19.5	19.3	17.7	16.5	17.1	18.1	19.1	20.1	21.1	22.1	
Additional Car Purchases											
- 35 Year Life	--	--	--	--	78	78	78	151	151	151	687
Average Age	19.5	19.3	17.7	16.5	17.5	17.5	17.5	17.3	17.3	17.3	
- 30 Year Life	--	--	--	--	91	91	91	176	176	176	921
Average Age	19.5	19.5	17.7	16.5	17.0	16.5	15.5	15.5	15.5	15.5	

NOTES: 1. The first ten cars of the R62 class were delivered in 1983 and are not shown here.
2. The retirement schedule does not show the retirement of 102 R16 cars which took place during 1983 as a result of improved fleet reliability in the IND/BMT.
3. The fleet size shown here are year-end projections.

CAR OVERHAUL
(Category T-2)

In 1981, the Authority began the Car Overhaul Program (COP), which is designed to complement the regular inspection of subway cars by the systematic replacement of selected car components. The Five Year Capital Program allocates $633 million to this program and other car related projects for the 1982-1986 period. Continued investments in the Car Overhaul Program and other projects during the 1984-1988 period will enable the fleet to reach a state of good repair by 1988. Subsequent investments during the 1989-1993 period will maintain and improve the performance and reliability of the fleet.

In the first two years of the Five Year Capital Program, 1982-1983, $284 million was identified primarily for projects involving the special retrofit and repair of specific car systems that are subject to high failure rates as a result of design deficiencies or excessive wear. The Five Year Capital Program provides an additional $349 million for the period 1984-1986. During the seven year period 1987 - 1993, $709 million in additional funds is required to continue the Car Overhaul Program and other car related projects, bringing the ten year investment for this program to $1,058 million.

TABLE 8
CAR OVERHAUL
10 YEAR CAPITAL NEEDS 1984-1993
($ millions)

	1984-88	1989-93	Total
Achieve a State of Good Repair	$567	-0-	$567
Normal Replacement	-0-	$413	413
New Intiatives	78	-0-	78
Total	$645	$413	$1,058

The most significant component of the Car Overhaul Program involves the scheduled overhaul of car classes at specific mileage intervals. There are four overhaul elements:

- D Overhaul at 180,000 miles or approximately four years;
- E Overhaul at 360,000 miles or approximately eight years;
- F Overhaul at 720,000 miles or approximately 16 years; and
- G Overhaul at 1,080,000 miles or approximately 24 years.

The first major overhauls began in 1983 with the initiation of the R36 "G" Overhaul and the R44 "E" Overhaul. The "D" Overhaul Program -- designed as a minor overhaul -- began in 1982. As of September 1983, 86 "G" Overhauls, 72 "E" Overhauls, and over 1,400 "D" Overhauls had been completed. The "D" Overhaul is financed as part of the Authority's annual expense budget. It is projected that minor overhauls (D) will result in an increase in MDBF of 10%, while major overhauls (E, F and G) will result in a 25% increase in MDBF.

During the ten year period from 1984 through 1993, car overhauls will be performed on over 4,200 cars at a cost of $641 million. This work will include:

- $327 million for G Overhauls on the R33, R38, R40, and R42 car classes;
- $74 million for E Overhauls on the R36, R62, and R68 car classes; and
- $77 million for F Overhauls on the R44 and R46 car classes.

The Authority also plans to review the costs and benefits of complete car rebuilding. Car rebuilding is considered a possible alternative to the purchase of new cars. If test program results are positive, the R32 car class will be considered for rebuilding as an alternative to retirement and new car purchases. Any increase in spending for car rebuilding would be accompanied by a reduction in new car purchases.

In addition to the overhaul schedule, the Authority plans a number of new initiatives involving the improvement or installation of air conditioning equipment on IND/BMT cars. The percent of air conditioned cars in the IND/BMT is currently 48% and will increase to 56% in 1987 with the arrival of the R68 cars.

There are 382 cars of the R40 and R38 car classes which were not built with air conditioning. Funding ($17 million) for the installation of air conditioning on approximately 200 of these cars was included in the Five Year Capital Program. This project is scheduled for 1986 and will raise the proportion of air conditioned IND/BMT cars to 61%. Current plans call for the retrofit of the remaining R40 and R38 cars in 1987 at a cost of $20 million. This will increase the percentage of air conditioned IND/BMT cars to 67% by 1988.

The remaining non-air conditioned cars of the IND/BMT fleet are the R27, R30 and R32 classes. With the regular purchase of 78 new cars beginning in 1988, the R27 and R30 classes will be replaced with air conditioned cars by 1993. Extending the subway car procurement schedule outlined earlier, the R32 class will be replaced or rebuilt (and retrofitted with air conditioning) by 1999.

In addition to these air conditioning projects, 600 cars of the R40 and R42 cars currently have air conditioning units that are not sufficient to properly cool the cars. These cars were the first to be built with air conditioning and the technology has improved considerably since that time. Modular air conditioning units could be installed in these cars at an estimated cost of $30 million. There are no funds identified for this project in the remaining three years of the Five Year Capital Program. Adjustments and deferrals to the present Car Overhaul Program, however, may allow some Five Year Capital Program funds to be used for at least a portion of this work during the 1984-1986 period. The remaining work and any deferred projects would be completed during the 1987-1988 period.

Finally, an additional $242 million has been targeted for special car retrofit projects during the ten year period 1984-1993. Of this total, $124 million or 51% is scheduled for specific projects during the three year period 1984-1986. During 1987-1993, $118 million will be used for additional projects that will increase the reliability of the Rapid Transit fleet by replacing obsolete car components with more efficient and reliable units. Retrofit projects include the installation of new air compressor units, new door opening mechanisms, and improved propulsion equipment. In addition, these funds will be used to standardize car components across car classes in order bring the components of older cars to a comparable level with the newer cars in the fleet. This will allow the older cars to benefit from advances in car design and engineering and will enable the interchange of components across car classes.

BUS PROCUREMENT
(Category T-3)

The Transit Authority currently operates a fleet of approximately 4,000 transit buses. These buses provide service throughout Manhattan, Brooklyn, the Bronx, Staten Island and, to a more limited extent, Queens. (The Queens service is supplemented by several private bus lines.) In 1983, buses operated by the Authority carried more than 513 million passengers.

Historically, the Authority's capital investment in buses has been erratic. During the ten year period 1972 to 1981, the Transit Authority invested $500 million to purchase buses--an average annual rate of $50 million. Annual investment levels during that ten year period varied widely, however. No bus purchases were made in four of those ten years, while more than 1,650 buses were purchased during the two year period 1980 to 1981 at a cost of approximately $360 million.

By comparison, the Five Year Capital Program provides funding -- $336 million -- to support a steady bus purchase program of 325 buses annually during the years 1982 to 1986. The Executive Capital Budget for January 1984 to June 1985 reallocates a portion of these funds to support higher priority infrastructure work and to provide the Authority with the opportunity to test bus prototypes. Consequently, no bus purchase is planned in 1984.

An assessment of the Transit Authority's capital needs over the next ten years indicates that the rate of expenditure for bus purchases under the Five Year Capital Program must be maintained. The Authority's capital needs for the bus program are estimated at $657 million over the next ten years -- $301 million for the period 1984 to 1988 and $356 million for the period 1989 to 1993. Of this total, $608 million will be necessary to fund the purchase of 2,925 standard buses between 1985 and 1993.

The remaining $49 million in identified capital needs for the bus program stems from new program initiatives, specifically the development and implementation of an automatic fare collection system and the purchase of 100 articulated buses. The Five Year Capital Program already provides $18 million to design and install an automatic fare collection system. Additional funds of $5 million will be required during the 1989 to 1993 period for replacement and reinvestment in this system. Finally, additional funding of $26 million will be required over the ten year period to purchase articulated buses.

The Authority's ten year capital needs for the bus program are summarized in the table below and briefly explained in the following sections.

TABLE 9
BUS PROCUREMENT
10 YEAR CAPITAL NEEDS 1984-1993
($ millions)

	1984-88	1989-93	Total
Achieve a State of Good Repair	$270	-0-	$270
Normal Replacement Cycle	-0-	$343	343
New Initiatives	31	13	44
Total	$301	$356	$657

State of Good Repair

A state of good repair for the bus fleet is defined here as an operating fleet comprised of buses that are no more than 12 years old, reflecting the average useful life of transit buses defined by the American Public Transit Association. The active bus fleet currently operated by the Transit Authority is composed of approximately 4000 buses, four percent of which are older than 12 years. Additionally, five percent of the active fleet is currently twelve years old and, given a 12 year lifespan, should be retired within a year.

A continuing bus purchase program will be required to eliminate all overage buses from the active fleet. Assuming a fleet size of about 4000, a steady purchase program of 325 buses per year would eliminate all buses more than 12 years old from the operating fleet by 1989 (see Table 10 below). This goal would require purchasing 1300 buses during the 1985 to 1988 period at a cost of $270 million. This program of investment (in combination with normal bus replacement and improved maintenance) would contribute to improved bus fleet reliability.

TABLE 10
AGE DISTRIBUTION OF BUS FLEET
UNDER BUS PURCHASE PROGRAM 1984-1993

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
New Bus Purchase:	-0-	325	325	325	325	325	325	325	325	325
Age Class:										
Over 12	9%	9%	7%	0%	1%	0%	0%	0%	0%	0%
8 to 12	25	24	18	17	29	42	42	42	35	34
4 to 7	29	42	50	58	37	25	25	25	32	33
3 & Less	37	25	25	25	33	33	33	33	33	33
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Normal Replacement Cycle

The goal of a normal replacement program is to establish an ongoing schedule of bus purchases that will attain a bus fleet with an even age distribution, assuming retirement after twelve years. The age distribution of the Authority's bus fleet is currently uneven. About 40 percent of the fleet is comprised of buses that were purchased in 1980 and 1981 and hence is about three or four years old. Moreover, the current fleet does not contain any buses that are five, six, eight, or ten years old, reflecting the fact that no buses were purchased in 1974, 1976, 1978, or 1979. This uneven age distribution of the bus fleet increases the Authority's vulnerability to problems with a particular bus class or series (as evidenced by the service disruptions that accompanied the 1980 Grumman problems).

As stated above, the planned purchase of 325 buses per year for the period 1985 to 1988 would bring the bus fleet to a state of good repair by 1989. Continuation of this purchase program beyond 1988 would place the bus purchase program on a normal replacement cycle. The purchase of 325 buses annually during the period 1989 to 1993 (at a total cost of $338 million) would result in an even age distribution across the bus fleet by 1993 (see Table 10.)

New Program Initiatives

The Five Year Capital Program allocates $18 million for designing and installing an automatic fare collection system on buses. As presently contemplated, electronic card-readers will be installed on buses to supplement existing fareboxes. Implementation of this program initiative is planned for the five year period 1984 to 1988. Additionally, the projected capital needs for the period 1989 to 1993 includes $5 million to support a normal replacement or reinvestment program for the new system.

A second program initiative anticipated in this area is the purchase of articulated buses. The addition of 100 articulated buses to the operating fleet would enable increased bus capacity and service levels along high ridership routes where shorter headways may not be feasible. Anticipated capital needs for this initiative include $13 million during the 1984 to 1988 period to fund the purchase of 50 articulated buses and an additional $13 million during the 1989 to 1993 period to fund the purchase of another 50 articulated buses.

PASSENGER STATIONS
(Category T-4)

The New York City Transit Authority operates 465 passenger stations which serve as entry points for more than three million daily Rapid Transit riders. There are 269 underground stations, 156 elevated stations, and 40 stations at grade, embankment or open cut locations. The oldest station dates back to 1904 while the newest station (57th Street and 6th Avenue) was built in 1968.

The Five Year Capital Program allocates $569 million for passenger stations. An additional $2,539 million would be required, however, to bring all passenger stations to a state of good repair. (A state of good repair for stations is defined as the completion of the station improvement program -- e.g., lighting and public address systems -- and the comprehensive modernization of all 465 stations.) While this level of investment would result in a state of good repair for stations, it is not possible or practical to commit this level of funds by 1993 because of scheduling constraints and competing priorities. As such, this needs assessment only includes a portion of the funds required to complete the station improvement and modernization program. Under these assumptions, $1,199 million is needed for the passenger station program during the 1984-1993 period. Table 11 identifies the investments required for passenger stations during the ten year period.

TABLE 11
PASSENGER STATIONS
10 YEAR CAPITAL NEEDS 1984-1993
($ millions)

	1984-88	1989-93	Total
Achieve State of Good Repair	$296	$463	$759
Normal Replacement	10	110	120
New Initiatives	109	211	320
Total	$415	$784	$1,199

There are three major components (or subprograms) in the passenger station category. The first component is the station improvement program which is a series of small, separate work plans directed at all 465 stations. The second component, the station modernization program, is a comprehensive refurbishing and upgrading of selected stations. The third component involves structural changes and adjustments at a limited number of stations. Table 12 summarizes the cost over ten years for each of the three passenger station sub-programs.

Station Improvement

The station improvement program consists of seven elements.

1. Escalators: There are 115 escalator units in passenger stations. These units are currently replaced on a life-cycle basis of 30 years. It is estimated that $37 million will be necessary to continue the normal replacement of escalator units. Approximately 25 units will be replaced or modernized during the ten year period.

2. Elevators: At the present time, the Authority operates 30 elevators in passenger stations. These units are currently replaced on a life-cycle basis of 30 years. It is anticipated that $7 million will be necessary to continue this normal replacement cycle during the ten year period.

3. Platform Roofs and Canopies: Most outdoor stations have canopy roofs that protect passengers waiting for trains. These structures are subject to deterioration due to exposure to weather conditions. In order to bring all roofs and canopies to a state of good repair by 1993, it is estimated that $80 million will be necessary to replace roofs and canopies at approximately 100 stations.

4. Lighting: The Five Year Capital Program allocates $19 million for the completion of a program to install fluorescent lighting on platforms at all underground stations. By 1986, all underground station platforms will have fluorescent lighting. Approximately 76 above ground stations will still be without platform fluorescent lighting, however. It is estimated that $38 million will be needed to equip these stations with new lighting, thereby completing the platform lighting program by 1988.

   In addition to the platform lighting effort, nearly 200 stations still require the installation of fluorescent lighting in mezzanine areas. Many of these areas are large open spaces (particularly in the IND, similar to West 4th Street) that passengers must cross to reach control areas or to switch trains. It is estimated that $100 million will be necessary to install lighting in these areas by 1993.

Finally, during the ten year period, the platform-level fluorescent lighting at approximately 100 stations will be at the end of its useful life. These stations were the first to receive fluorescent lighting and some of the hardware dates back to 1948. It is estimated that $30 million will be necessary for the normal capital reinvestment needs of existing platform lighting during the 1989-1993 period.

5. Public Address Systems: Nearly 270 stations have or will have public address systems installed by 1986. Approximately 200 stations still require public address systems. It will cost approximately $40 million to complete this program by 1988. In addition, it is estimated that the capital reinvestment needs of this component will be approximately $30 million during the 1989-1993 period as electronic equipment in these systems is subject to high rates of replacement.

6. Fare Collection: The Five Year Capital Program identifies $70 million for the installation of an automatic fare collection system throughout the Rapid Transit system. These funds include the purchase of fare collection equipment as well as any required structural alterations to the fare collection areas of each station. By 1988, the new fare collection systems will be installed throughout the system. It is anticipated that the capital replacement and repair needs will be significant in the first five year period of operation. An additional $16 million has been identified for this purpose in the 1989-1993 period.

7. Noise Abatement: During the 1984-1993 period, the Authority plans a major new initiative to reduce noise levels in the 269 underground passenger stations throughout the system. All comprehensive modernizations scheduled at underground stations will include appropriate noise treatments. The cost of these treatments are included in the modernization costs outlined below. For approximately 100 underground stations not scheduled for modernization during this period, a separate noise abatement improvement program is proposed. This program would involve the installation of noise abatement treatments such as sound absorptive barriers or material between tracks and under platforms at these 100 stations. It is estimated that these improvements will cost approximately $1 million per station and will result in an average noise reduction

of 6 decibels -- equivalent to a 25% reduction in perceived noise levels. Approximately 100 underground stations are not scheduled for modernization or noise treatment during the 1984-1993 period. These stations will receive noise treatment or modernization after 1993.

TABLE 12
PASSENGER STATIONS
10 YEAR CAPITAL NEEDS BY COMPONENT, 1984-1993
($ millions)

	State Of Good Repair	Normal Replacement	New Initiatives	Total
A. Station Improvement Program:				
1. Escalators	-0-	$ 37	-0-	$ 37
2. Elevators	-0-	7	-0-	7
3. Platform Roof/Canopy	$ 80	-0-	-0-	80
4. Lighting	147	30	-0-	177
5. Public Address	40	30	-0-	70
6. Fare Collection	-0-	16	$ 70	86
7. Noise Abatement	-0-	-0-	100	100
Subtotal	$267	$120	$170	$557
B. Station Modernization:	$492	-0-	-0-	$492
C. Structural Adjustments:	-0-	-0-	$150	$150
D. Total	$759	$120	$320	$1,199

Station Modernization

The second component of the passenger station category involves the comprehensive modernization of selected stations. The modernization of a station generally includes the installation of new wall and floor finishes, new lighting, improved signage, new public address systems, and (where appropriate) rearrangement and improvement to the fare collection area, mezzanine area, and stairways and entryways. In addition, modernized stations also receive noise abatement treatments aimed at reducing high levels of platform noise. Typical noise abatement treatments include the installation of sound absorptive ceilings, barriers between tracks, and under platform treatments.

The Five Year Capital Program allocates $244 million to modernize passenger stations. Almost 75% of these funds, or $185 million, has been placed in reserve pending a review of more pressing infrastructure needs. As currently envisioned under the Executive Capital Budget for the period January 1984 - June 1985, funds programmed for station modernization may be required to finance additional infrastructure work. The actual level of funds required and consequently the number of stations to be completed will depend on the specific level of additional infrastructure work required. Under this adjusted program, it is anticipated that between 50 and 60 stations will receive comprehensive modernizations by the end of 1986. An additional 20 to 30 stations that were originally scheduled for the 1984-1986 period are now scheduled for the 1987-1988 period.

By 1989, approximately 135 stations or 29% of the 465 stations will have received comprehensive modernizations. Nearly 63% of all Rapid Transit riders will pass through these stations during their daily trips. Approximately 330 stations account for the remaining 37% of the riders. An additional 70 stations are scheduled for modernization (14 per year) during the 1989-1993 period. An estimated $300 million will be needed for this level of station modernization and will result in a total of 205 (44%) modernized stations. The completion of these additional 70 high passenger volume stations will reach an additional 13% of the riding public. Consequently, 75% of all Rapid Transit passengers will pass through modernized stations by 1993.

To reach the remaining 251 stations and the remaining 25% of the Rapid Transit riders, an additional $1,341 million would be needed. These costs are not included in the capital needs for the 1984-1993 period.

Structural Adjustments

The third component of the passenger stations category involves structural adjustments to a number of passenger stations. During the 1987-1993 period, $150 million has been identified for this sub-program. These projects involve changes to the structural layout of a station to provide new transfer connections or improved platform and street accessibility. One project that would be considered under this program is the construction of an uptown connection between the IRT and the IND at the Bleecker Street and Broadway-Lafayette Street complex to complement the existing downtown connection. Another would be improving the platform accessibility to the Whitehall Street - South Ferry complex.

Another element of the structural adjustment program involves an effort to reconfigure and expand the entryways of selected passenger stations in midtown and downtown Manhattan. There are a number of high passenger volume stations (particularly on the IRT) that currently have very narrow entry points from street level. This new initiative will focus on widening passenger entryways (where feasible) in the most congested of these areas. A passenger volume survey will be needed as well as a technical feasiblity study to determine the best location for this work. This effort will complement existing efforts under the midtown zoning regulations that require the construction of in-building subway entrances in areas where new construction overlaps existing subway entrances.

TRACK

(Category T-5)

The New York City Transit Authority operates 707 miles of mainline and 122 miles of yard track. Track sections are classified as straight (tangent) or curved (either guarded or unguarded). The track network is supported by 2,459 switches that facilitate train movements and operations. Additionally, over 800 miles of contact rail (or third rail) supply 600 volt, direct current propulsion power to the transit cars. All track, switches and contact rail are supported by a system of ties and fastenings to insure proper gauge and alignment. Ballast provides drainage and support, except on open deck elevated structures where drainage is provided by the structure.

The Authority committed $383 million in capital funds for the replacement and reconstruction of track during the ten year period ending in 1983. Of this total, $160 million was scheduled during the first two years of the Five Year Capital Program -- $92 million was allocated for track rehabilitation and $68 million was allocated for the replacement of switches and contact rail and the installation of continuous welded rail and rubber rail seats. The Five Year Capital Program allocates an additional $230 million for the track program during the final three years of the program, 1984-1986.

The Five Year Capital Program, when compared to prior years, represents a major increase in capital resources devoted to the replacement and reconstruction of track. Nevertheless, financial support must be increased further in order to reverse deterioration of the track system. The Executive Capital Budget for the period January 1984 to June 1985 reflects these additional funding needs by making it possible to reallocate capital funds from other program categories to the track program in the event that current analysis demonstrates such a need.

This ten year needs report reflects a track program that will eliminate all deteriorated track and switches by 1990 and assure sufficient resources for the normal replacement of track components thereafter. The cost of this program is $1,138 million over the period 1984 to 1993 -- an increase of almost 200% over the past ten year period. The following table summarizes the proposed program.

TABLE 13
TRACK
TEN YEAR CAPITAL NEEDS 1984-1993
($ millions)

	1984-88	1989-93	Total
Achieve a State of Good Repair	$368	$ 13	$ 381
Normal Replacement	$270	436	706
New Initiatives	21	30	51
Total	$659	$479	$1,138

State of Good Repair

The Authority has recently conducted a survey of track conditions which is now being verified. This survey, along with historical data, demonstrates that a shortfall in track replacement and reconstruction has occurred in recent years. In order to rectify this situation, the Authority is proposing a program of track replacement and reconstruction at locations defined as seriously deteriorated and requiring reconstruction during the next seven years. Under this program, most of the backlog in track work (currently estimated to be over 100 miles) will be eliminated between 1984 and 1988, with the balance eliminated by 1990.

The current Authority policy is to replace Type I track (wood ties in stone ballast) with Type II track (wood tie blocks in concrete ballast) in locations where track and roadbed conditions warrant major reconstruction. (Type II track is generally less costly to maintain, has a longer life cycle, and provides more reliable support and drainage than Type I track.) About 25 miles of the track work identified in the condition survey will involve major reconstruction of Type I track and therefore will be converted to Type II as part of this program effort. Similarly, knuckle and lap switches (considered to be obsolete) will be replaced with American Railroad Engineers Association standard switches where appropriate. Nevertheless, an estimated 150 miles of Type I track and a number of knuckle and lap switches will remain throughout the system after all deteriorated track and roadbed is brought to a state of good repair. An additional $900 million (not included in this needs assessment) would be required to convert all remaining Type I track to Type II.

The capital investment required to bring track to a state of good repair by 1990 is estimated at $381 million -- $368 million during the period 1984 to 1988 and $13 million during the period 1989 to 1990.

Normal Replacement Life Cycle

Each classification of track and each component of the track system has a different useful life. Straight (tangent) track lasts an average of 20 years, while short radius curved track lasts an average of five years. Based on life cycle estimates for various components of the track system, a normal cycle of track replacement (exclusive of contact rail) would require the annual installation of approximately 10,400 tons of new rail per year. In addition, approximately 1,000 tons of guard rail would have to be removed and reinstalled (not replaced) as part of the normal replacement of guarded curve track. A life-cycle replacement program would therefore require approximately 11,400 tons of rail installation annually -- approximately 65 miles of track.

Track roadbed, fasteners, contact rail, and switches must also be replaced on a normal cycle. Most of this work (encompassing the conversion of Type I track to Type II, the rehabilitation of Type II roadbed, and the installation of contact rail, welded rail and rubber rail seats) will be carried out as part of the annual program of normal track rehabilitation described above.

In order to sustain this level of ongoing track and roadbed replacement, expenditure levels should be increased beginning in 1984 and continued into the future. Total ten year needs for normal replacement of track are estimated at $706 million over the period 1984 to 1993.

New Initiatives

Several modest program initiatives will also require capital funding over the next ten years. First, in order to facilitate the flexibility of operations, new crossovers will be installed where it is determined that a substantial contribution to the quality of service would result. Total ten year capital needs for this program are estimated at $46 million.

The second program initiative involves the installation of rubber rail seats on elevated structures located within 200 feet of 13 schools. These rubber rail seats will reduce excessively high noise levels at specific locations which have been identified as "noise-sensitive". Studies have shown that the noise levels experienced at schools within 200 feet of elevated structures have a significant effect on reading scores. Total ten year capital needs for this program are estimated at $5 million.

LINE EQUIPMENT
(Category T-6)

The Authority's Rapid Transit system contains a multitude of electromechanical systems. The basic elements of this network are tunnel lighting, ventilation plants, pumping equipment, and power distribution equipment.

During the period 1974 through 1983, the Authority committed $120 million for line equipment projects. Of this total, 46% was committed during 1982 and 1983, the first two years of the Five Year Capital Program. This ten year rate is far below the rate of investment required to bring the system to a state of good repair.

The Authority proposes to invest $935 million for projects in the line equipment category over the period 1984 through 1993. Of this total, $86 million is already provided in the final three years of the Five Year Capital Program. A large portion of the projected capital needs for line equipment -- $781 million or 84% -- will be necessary to bring the system to a state of good repair by 1993. The only element that will not reach a state of good repair by 1993 is tunnel lighting. The $459 million allocated for tunnel lighting represents only a portion of the total $1,300 million required to bring this element to a state of good repair. The rate of investment assumed here reflects the constraints of installing new tunnel lighting under service. The following table summarizes the projected commitments in the line equipment category:

TABLE 14
LINE EQUIPMENT
TEN YEAR CAPITAL NEEDS 1984-1993
($ millions)

	1984-88	1989-93	Total
Achieve a State of Good Repair			
-Tunnel Lighting	$134	$325	$459
-Ventilation Plants	70	106	176
-Pumping Facilities	85	61	146
Subtotal	$289	$492	$781
Normal Replacement			
-Pumping Facilities	-0-	6	6
-Power Distribution	71	77	148
Subtotal	$ 71	$ 83	$154
New Initiatives	-0-	-0-	-0-
Total	$360	$575	$935

Projected capital needs for the four major components of line equipment are summarized below:

Tunnel Lighting

Tunnel lighting provides illumination for passengers in emergency situations, motormen who need light to detect possible obstructions on the right of way, and trackwalkers who check for defects in track structures. Existing tunnel lighting is comprised of 473 miles of series connected banks of incandescent lights. These lighting systems were installed as long as 79 years ago. The wires, conduits, and other components are deteriorated and require rehabilitation or replacement. Moreover, since the systems are series connected, one burned-out bulb makes the entire five-light series inoperative.

Tunnel lighting projects funded under the ten year program will entail the replacement of series connected incandescent fixtures with parallel connected fluorescent fixtures. Fluorescent lights provide greater illumination and are less expensive to maintain and operate. Under the proposed program, 168 miles of tunnel lighting will be replaced or upgraded over the ten year period 1984 to 1993. The cost to convert incandescent lighting fixtures to fluorescent fixtures is estimated at almost $3 million per mile. The capital requirement for tunnel lighting rehabilitation will therefore total $459 million over the period 1984 to 1993.

Ventilation Plants

The ventilation system consists of over 160 fan chambers containing more than 200 fans. In an emergency, these large fans provide ventilation through one shaft while fresh air is supplied through an adjacent shaft. During normal operations, ventilation of train tunnels is achieved through the piston action of the trains.

Most of the current inventory of ventilation equipment is original equipment and well beyond its useful life. The ten year program includes funds for the rehabilitation of 92 overaged fan chambers. This program will entail replacement of obsolete ventilation fans and dampers at a cost of approximately $2 million each. All of these fans and dampers are currently overaged and very costly to maintain. All new installations will include remote supervisory control capacity. Estimated capital requirements for this program are $176 million over the ten year period 1984 to 1993.

Pumping Facilities

Pumping equipment is used to discharge water that seeps into the subway tunnels. This function has become increasingly important as rising water tables, broken water or sewer mains, and rain run-off have resulted in seepage of millions of gallons of water per day into subway tunnels. Failure of the pumps to meet these demands could result in service disruption, structural damage, or flooding.

The current drainage system consists of 250 pump rooms equipped with approximately 800 pumps. Many of these pumps are original equipment, require a high level of maintenance, and often are difficult to maintain because parts are not available. About 62% of these pump rooms should be rehabilitated and re-equipped over the next ten years.

The ten year program includes funds for the rehabilitation of 150 pump rooms which will include the replacement of 350 pumps. This program will eliminate all overaged pumps by 1993 at an estimated cost of $1 million per pump room. Replacement pumps will generally be submersible. Where necessary, sump capacity in pump rooms will be enlarged to accommodate the larger capacity pumps needed to handle increased water infiltration. The total program cost is estimated at $146 million over the 1984 to 1993 period.

The ten year program also includes funds for the normal replacement of pumps. An estimated $6 million will be required during the period 1984 to 1993 to fund the replacement of 18 pumps located in 6 pump rooms on the IND. These pumps will reach the end of their useful life during this period and will be replaced as part of a normal replacement or reinvestment program.

Power Distribution

The power distribution system is currently in an acceptable state of repair. Consequently, funds are provided under the ten year program to institute a normal replacement and reinvestment program for power distribution cables and equipment. Under this program, power distribution cables and equipment are to be replaced at a rate of about 31 miles per year in conjunction, where possible, with comprehensive mainline rehabilitation projects (zone & line contracts) at a cost of less than $1 million per mile. Total program costs over the ten year period are estimated at $148 million.

LINE STRUCTURES

(Category T-7)

Two hundred and thirty (230) route miles of structure make the New York City transit system the most complex public transit network in the United States. This network includes approximately 137 miles of tunnel structure with 14 underwater crossings, 70 miles of elevated structures, and 23 miles of embankment or open cut structures. The structural network includes river tunnels, rock tunnels, soft ground tunnels, underground concrete and steel frame structures, steel and concrete elevated structures, trestles, bridges, embankment and retaining wall sections, and many other facilities.

Maintenance of these structures is essential to the provision of safe and reliable transit service. Accordingly, the Five Year Capital Program provides $241 million for structural rehabilitation during the period 1982 to 1986. The Executive Capital Budget for January 1984 to June 1985 assumes that additional capital program funds will be reallocated from other program categories to support increased line structure work during the 1984 to 1986 period.

The funding levels for line structure rehabilitation during the 1982 to 1986 period represent substantial increases over historical levels. During the ten year period, 1972 to 1981, less than $79 million was committed for line structure rehabilitation. Nevertheless, current funding levels are substantially below the estimated ten year capital needs for line structure rehabilitation.

Current estimates of capital needs indicate that $1,333 million will be required over the ten year period 1984 to 1993 for line structures. These estimates are preliminary, however, and reflect the Authority's experience to date with structural rehabilitation and with the cost of completing such work. Efforts are currently under way to better assess structural rehabilitation needs systemwide. These efforts are hampered, however, by the difficulty of determining structural conditions, particularly where underlying steel structures are encased in concrete walls. The estimated ten year capital needs summarized below are preliminary and based on the best information available.

TABLE 15
LINE STRUCTURES
10 YEAR CAPITAL NEEDS 1984-1993
($ millions)

	1984-88	1989-93	Total
Achieve a State of Good Repair			
-Elevated and Embankment Structures	$215	$105	$ 320
-Subway Structures and Water Conditions	236	308	544
-Other Structural Elements	73	127	200
Subtotal	$524	$540	$1,064
Normal Replacement	40	101	141
New Initiatives	-0-	128	128
Total	$564	$769	$1,333

There are several basic line structure types, each requiring a comprehensive rehabilitation program as described below.

Elevated and Embankment Structures

The New York City transit system encompasses 70 miles of elevated structures. Most of these elevated structures are steel. These steel structures are subject to stresses due to movement under live loads (trains, wind, etc) and exposure to the weather. Under extreme conditions, the steel members eventually corrode and may crack. In stations with underhung mezzanines, through span girders encased in concrete (which support concrete decks above) are subject to even more severe deterioration due to ponding and seeping of water from the above deck. This deterioration undermines the integrity of the structures, thereby necessitating rehabilitation. Such rehabilitation generally includes the repair or replacement of major structural members such as through span webs, rocker pins or expansion plates, top flange angles, top tie-in angles, and column bases.

Open cut or embankment structures comprise 23 miles of the Authority's structural system. Open cut or embankment structures are earthen structures supported by retaining walls. Bridges, usually associated with embankment structures, allow vehicular and pedestrian traffic to cross over or under the earthen structures. Structural problems associated with

open cut or embankment structures are generally limited to deterioration of the retaining walls and bridges. Deteriorating retaining walls compromise the structural integrity of the cut or embankment. The bridges are generally made of steel and suffer the same kind of deterioration as that experienced on steel elevated structures.

During the first two years of the Five Year Capital Program, only 3.5 route miles of elevated structure on the IRT-Flushing line were scheduled for rehabilitation while no rehabilitation work was scheduled for embankment structures. Moreover, little substantial rehabilitative work on these structures has been undertaken during past years. Consequently, substantial portions of elevated and embankment structures will require rehabilitation during the ten year period 1984 to 1993. Based on engineering cost estimates for comprehensive structural rehabilitation on six major elevated lines and for repair of retaining walls on the Franklin Avenue shuttle, the estimated cost of such work is $320 million over the ten year period. An additional $51 million will be required during this period to ensure that these structures remain in a state of good repair as part of a normal replacement cycle. This figure represents the average annual capital funding necessary to reinvest in these structures assuming a 50 year useful life.

Subway Structures

The bulk of the system's structural network consists of subway or tunnel structures. Most of the structural problems in subways have, to date, been associated with water seeping into tunnels. The most severe problems occur where the groundwater table rises or the course of underground streams change. This results in a water condition where increased water infiltration washes away soil at the subgrade, thus threatening the stability of the structure. In other areas of the subway structure, normal water inflow from rain run-off or broken water mains causes deterioration of tunnel and ventilation structures. This deterioration results in corroded steel structural members and spalled concrete. If left unattended, these conditions will weaken the structure and accelerate the deterioration of track, signals and other components of the right of way infrastructure.

Where severe water conditions have developed, installing pumps in a deep well or a series of shallow wells will usually lower the water table near the subway structure. In extreme cases, sections of the tunnel may have to be rebuilt. By comparison, normal deterioration usually requires more simple structural work that consists of repairing water leaks, rebuilding or repairing ventilation structures, and repairing corroded steel bents and spalled concrete.

The Five Year Capital Program provides $67 million for structural work in subways during the 1982 to 1986 period. Some $30 million of this amount was allocated for the first two years of the Five Year Capital Program. These funds have been used to remedy severe water conditions at four locations.

Based on engineering cost estimates for similar work on the 4th Avenue line in Brooklyn and the 8th Avenue line in Manhattan, the ten year needs for sealing water leaks and rehabilitating ventilation structures is $384 million. An estimated $160 million will be required to remedy severe water conditions throughout the subway system. This figure is preliminary since estimating the number and severity of water conditions is very difficult. In addition, an estimated $57 million will be required for rehabilitation of subway structures to ensure their structural integrity as part of a normal replacement cycle.

Other Structural Elements

The line structures category includes several other elements that require rehabilitation in order to ensure safe transit service. These elements include discharge, fire, and water lines and wooden mezzanines and stairways.

Discharge, fire and water lines are the plumbing components that pump water away from underwater tunnels and provide fire protection in the event of fire. These elements are critical to the safety of the rapid transit system. Their replacement is necessary due to corrosion caused by age and electrolysis. An estimated $23 million will be required over the ten year period 1984 to 1993 in order to rehabilitate these deteriorated lines.

Similarly, a program has been established to eliminate wooden mezzanines and stairways from the system. Such elements are still in use at approximately 90 elevated stations throughout the system. These wooden components are subject to rapid wear and prone to fire. (Wooden platforms have already been replaced with pre-stressed concrete platforms.) About $177 million in capital funds will be required over the next ten years to replace all wooden mezzanines and staircases with more durable, fire-resistant components. An additional $33 million will be required for an ongoing program of replacement and rehabilitation efforts for these structural elements.

New Initiatives

The Authority proposes to eliminate the grade crossing on the Brooklyn IRT service between the Nostrand Avenue and Eastern Parkway lines (referred to as Rogers Junction) in order to increase track capacity and reduce train delays. Currently, the only connection between the Nostrand Avenue line and the express tracks of the Eastern Parkway line entails a grade crossing with the Eastern Parkway line local tracks east of the Franklin Avenue station. This situation constrains service on the New Lots and Broadway/7th Avenue lines and significantly increases travel time at this junction. Eliminating this grade crossing will require significant structural modifications and relocation of tracks. The estimated cost of this project is $128 million.

SIGNALS & COMMUNICATIONS
(Category T-8)

The Authority operates an extensive signal system which contains approximately 10,000 wayside signals, 8,700 automatic train stops, 110,000 relays, 12,000 track circuits, 18,000 insulated joints and numerous other components. Cables interconnecting all the components of the signal system span over 707 track miles and are suspended from messenger cables along the right of way, installed in ducts, or buried in trenches. The signal system controls the location of trains in relation to one another, as well as the speed of trains depending on the configuration of tracks (straight or curved) and the grade of the roadbed. The proper functioning of the signal system is critical to the safe operation of the rapid transit system.

During the period 1974 through 1983, the Authority committed $368 million for signal modernization and communications systems projects. Of this total, $80 million was committed in 1982 for the Brooklyn IRT service along the Eastern Parkway and Nostrand Avenue lines. This contract, referred to as the Zone I contract, was the first comprehensive mainline rehabilitation contract awarded by the Authority. It includes 21 miles of signal modernization work and a number of other mainline rehabilitation projects.

An additional $319 million in signal work was originally scheduled during the final three years of the Five Year Capital Program. A portion of this work will be deferred outside the Five Year Capital Program, however, in order to allow for other higher priority infrastructure work. Nevertheless, the level of signal work undertaken during the five year period 1982 to 1986 will be significantly higher than recent historical levels.

Despite the planned increase in signal and communications work, the signal system will not reach a state of good repair by 1993. The total estimated capital cost of bringing the signal system to a state of good repair is $1,782 million. This level of investment would be sufficient to modernize 396 miles of the signal system.

The Authority's ability to undertake this level of signal work is severely constrained by operational considerations, however. Consequently, the ten year capital needs identified in this document for signal work -- $914 million over ten years -- would be sufficient to modernize only a portion (199 miles) of the signal system. The remaining 197 miles of the system

would be modernized during the 1993 to 2003 time period (assuming the rate of capital commitment implicit in this document is continued) bringing the signal system to a state of good repair by 2003. Funds are not included in this needs assessment to institute a normal replacement cycle for signals, since achieving a state of good repair is accorded the highest priority. After 2003, however, $64 million will be required annually to support a normal replacement and reinvestment program for signals. The following table summarizes projected expenditures for signals and communications from 1984 through 1993.

TABLE 16
SIGNALS & COMMUNICATIONS
10 YEAR CAPITAL NEEDS 1984-1993
($ millions)

	1984-88	1989-93	Total
Achieve a State of Good Repair			
-Signal Modernization	$419	$495	$914
-Signal Relay Code System	35	10	45
-Antenna Cable	26	50	76
-Telephone Cable	18	25	43
-MOW Communications	2	--	2
Subtotal	$500	$580	$1,080
Normal Replacement			
-Communications Systems	$ 6	$ 15	$ 21
New Initiatives	-0-	-0-	-0-
Total	$506	$595	$1,101

Signal Modernization

The Authority has estimated that the normal useful life of signals is 50 years, based on the actual performance of the signal system. Given this estimate, the Authority now operates 349 miles of overaged signals (or 49% of the total signal mileage). Moreover, absent continuing signal modernization, the total miles of overaged signals will increase to 396 miles (or 56% of total signal mileage) by 1993.

In order to reduce and eliminate the quantity of overaged signals in the system, an accelerated program of signal modernization is necessary. Accordingly, this capital needs assessment is predicated on a program to replace approximately 22 miles per year for 17 of the next 20 years at a cost of four to five million dollars per mile. This rate of replacement is about 75% higher than the level now scheduled in the Five Year Capital Program. At this rate, the percentage of overaged signals will drop to 28% by 1993 and be completely eliminated by 2003. Thereafter, 14 miles of the signal system should be modernized

each year (at an estimated cost of $64 million annually) in order to maintain the system in a state of good repair.

This planned program of work is aimed at replacing all obsolete signal equipment. At the same time, however, signal work on the BMT lines and at critical merge points will be designed with signal system logic that allows increased running speeds, increased track capacity and decreased headways. The Authority intends to continue using the zone contract concept in order to program signal replacement and comprehensive mainline rehabilitation simultaneously.

Signal Relay Code System

The signal relay code system transfers information regarding train location to a remote or central location so that train movements can be controlled and monitored. Approximately 14 miles of the relay code system is multiplexed and has proven undependable. All 14 miles of the multiplexed system should be replaced with direct wire control equipment. A direct wire system is one in which, generally, individual wires serve individual functions. The direct wire system has proven more reliable. The estimated cost of replacing the 14 miles of signal relay code system is $45 million. This investment will bring the signal relay code system to an acceptable operating standard by 1993.

Communications

To operate the subway system, the Authority maintains an extensive communications system. The Rapid Transit Command Center at Jay Street is capable of direct, two-way communications with every train on the system. The Command Center also enables two-way communication with trainmasters, dispatchers and towermen. In addition, various operating departments (such as the Transit Police and Maintenance of Way) have radio systems to coordinate their functions throughout the system. The Authority also maintains a Centrex telephone system which handles incoming and internal calls to numerous locations and offices. Much of the communications system is currently overutilized and past its economic life. In general, the electronic components of the communications system have a short life cycle and therefore require an ongoing program of reinvestment.

The total capital needs for the communications system are estimated at $142 million over the ten year period 1984 to 1993. The bulk of this investment -- $121 million -- will be necessary to rehabilitate the communications systems, thereby bringing it to a state of good repair. Another $21 million will be necessary to fund an ongoing program of replacment and reinvestment to ensure efficient and reliable communications.

POWER
(Category T-9)

The power system is currently comprised of 190 power substations which convert high voltage (14KV to 28KV) alternating current to 600 volt direct current. This power is distributed by a network of power distribution equipment and cables from substations to the third rail which, in turn, provides traction power for transit cars.

Since 1963, the Authority has funded a continuing program to modernize power substations and equipment in order to eliminate obsolete equipment and achieve a state of good repair. This modernization program was conceived as a 30 year program under which all substations and equipment would be modernized by 1993. Therafter, all power equipment would be replaced on a 35 year cycle. The program outlined in this ten year needs assessment covers the final 10 years of this 30 year modernization effort. All of the equipment to be replaced during this time period is well beyond its 35 year expected life.

The power modernization program encompasses two objectives. The first is to eliminate all obsolete rotary converter and mercury arc rectifier substation equipment and replace it with silicon diode rectifiers. The new equipment requires less maintenance and is less vulnerable to breakdown. In addition, the silicon diode rectifiers are more energy efficient and result in a three to four percent savings in electricity costs.

A second objective of the program is to eliminate manually operated substations in the IRT and BMT divisions and to construct a new centralized Power Control Center. This center (to be fully operational in 1987) will have the capability of controlling all substations from one location, including any additional substations necessary to support new routes under consideration. On the IRT and BMT divisions, new substations are being reconfigured with smaller capacity equipment to supply power to shorter sections of the transit system. As a result, the number of IRT and BMT substations will increase from 85 to 109. This reconfiguration will permit the rapid detection of faults on the system and the ability to sectionalize in the event of a subway failure. IND substations do not require reconfiguration; these only require replacement of obsolete rotary converter and mercury arc rectifier equipment.

In the ten year period ending in 1983, the Authority devoted considerable attention and resources to the power modernization program. The total capital resource allocation

for this period was $392 million. About 40% of this total was allocated for 1982 and 1983, the first two years of the Five Year Capital Program. During the 1974-1983 period, the modernization of 36 IRT-BMT substations and 28 IND substations was completed. This program of modernization has thus far allowed the Authority to eliminate 73 operating quota positions.

In the ten year period from 1984 to 1993, the Authority will complete the construction and equipping of the Power Control Center, as well as the modernization of the IRT, BMT, and IND substations. During this period, the final 42 IRT and BMT substations and 65 IND substations will be completed. At that time, the Authority will be operating 217 power substations, assuming three substations are added to support new routes. The following table illustrates the past progress and anticipated completion of the power modernization program.

TABLE 17
POWER MODERNIZATION PROGRAM
SUBSTATION COMPLETION SCHEDULE 1963-1993

Period	IRT-BMT	IND
1963-1973	31	12
1974-1983	36	28
1984-1993	42	65
Subtotal	109	105
New Routes	--	3
Total	109	108

The capital resources required to support the power modernization program during the 1984 to 1993 period total $532 million. A large portion of these needs -- $143 million or 27% -- will be funded under the final three years of the Five Year Capital Program.

During the 1984 to 1993 period, $28 million will be required to protect investments in substation enclosures constructed during the prior twenty year period. No additional investments to replace power equipment on a normal replacement life cycle will be required until the late 1990's. Upon completion of the power modernization program, however, a continuing annual investment of $30 million will be required to maintain the power system in a state of good repair and to protect against future deterioration. This investment level should support an annual program of enclosure rehabilitation and equipment replacement, as well as continuing capital investments in the Power Control Center.

The following table summarizes the anticipated level of capital resources required for the program as outlined above.

TABLE 18
POWER
TEN YEAR CAPITAL NEEDS 1984-1993
($ millions)

	1984-88	1989-93	Total
Achieve a State of Good Repair			
-Power Control Center	$ 46	$-0-	$ 46
-IRT and BMT Enclosures	63	4	67
-IRT and BMT Equipment	166	50	216
-IND Equipment	49	126	175
Subtotal	$324	$180	$504
Normal Replacement Cycle	8	20	28
New Initiatives	-0-	-0-	-0-
Total	$332	$200	$532

SHOPS AND BARNS
(Category T-10)

Capital investments in this category are of two types -- investments in the shops and barns that maintain the subway car fleet and investments in the shops that support the maintenance of track, structures and equipment on the right of way. The subway car fleet is inspected and repaired at 13 barns located throughout the system and at the 207 Street (Manhattan) and Coney Island (Brooklyn) main repair shops. The inspection and repair of the right of way is supported by more than three dozen facilities performing a variety of functions including the prefabrication of structural elements, track and switches, and the repair of signal, power distribution and line equipment.

In the ten years prior to the initiation of the Five Year Capital Program, 1972-1981, the Authority committed $196 million to support the capital needs of the shops and barns. The Five Year Capital Program allocates $485 million for the 1982-1986 period. More than half of these funds -- $284 million -- are scheduled for commitment during the remaining three years of the Five Year Program.

During the 1987-1993 period, an additional $244 million will be required to bring the Authority's shops and barns to a state of good repair, to initiate a normal capital replacement program, and to support a program of new initiatives. The total ten year capital investment needs required to support these programs are estimated at $528 million.

TABLE 19
SHOPS AND BARNS
10 YEAR CAPITAL NEEDS, 1984-1993
($ millions)

	1984-88	1989-93	Total
Achieve a State of Good Repair	$292	$36	$328
Normal Replacement Cycle	41	110	151
New Initiatives	30	19	49
Total	$363	$165	$528

State of Good Repair

The Five Year Capital Program allocates sufficient capital funds to achieve a state of good repair for all of the Authority's car maintenance barns and shops by 1986. Newly identified, high priority infrastructure work has necessitated the deferral of some barn and shop projects originally

scheduled for the 1982-1986 period, however. These projects have been added to the 1987 program and will be substantially completed by 1988.

The current rehabilitation efforts at car maintenance facilities are designed to address the deterioration resulting from underinvestment during past years and to provide new equipment and facilities to properly maintain a more modern subway car fleet. Major capital construction projects are scheduled for each of the 15 car maintenance facilities. The work to be completed includes:

- the rehabilitation of air, water and electrical systems, including ventilation, heating and air conditioning, sewage and drainage, and lighting;
- the repair and insulation of building walls, and the replacement of entrance doors to reduce heat loss;
- the repair of leaking roofs; and
- the renovation of employee facilities.

The cornerstone of planned operational improvements at the 13 barns is the construction of utility tracks. These enclosed areas will provide each barn with the ability to perform three major functions:

- undercar blowouts, wherein compressed air is directed at the mechanical parts of car electrical and control systems to remove steel dust, track dirt and carbon, thereby exposing parts and allowing for more thorough inspections and improved mechanical operation;
- the inspection and cleaning of car air conditioning equipment, which frees clogged condensor coils of steel dust and dirt; and
- car cleaning via application of a strong acid wash designed to remove graffiti from stainless steel car exteriors.

At the Coney Island shop, a bay will be added to provide column spacing adequate to permit the lateral movement of 75-foot IND/BMT cars. These cars must now be serviced at the 207 Street shop, which is otherwise dedicated to the IRT fleet. A contract for the construction of a major new facility at 207 Street -- a consolidated electrical repair shop to test components of car door operator, braking, ventilation and heating/air conditioning systems -- was awarded in 1982.

The Five Year Capital Program does not allocate adequate funds to bring existing right of way shops to a state of good repair, although major new initiatives are being undertaken with the development of the Linden Shop complex. The Maintenance of Way Department operates more than thirty major facilities as well as numerous smaller storage and employee sites, many of them not addressed by the present capital program. During the seven year period, 1987-1993, capital investments totalling $50 million will be required to bring these facilities to a state of good repair.

Normal Replacement Cycle

By 1988, the currently scheduled modernization of the Authority's car maintenance barns and shops will be complete and these facilities will reach a state of good repair. Additionally, some right of way shops will have reached a state of good repair by 1988. In order to keep these important facilities operating properly and to prevent the type of deterioration that has occurred in the past, it is necessary to reinvest in these facilities on a regular and planned basis. The useful life for these facilities is estimated at roughly 40 years. Consequently, an average investment of 12.5% of the value of those shops and barns in a state of good repair has been programmed for each of the two five year periods over the next decade. A value of $275 per square foot--the average cost of barn projects recently awarded--was used for car maintenance facilities. For right of way shops, a similar methodology was used. The 1984-1993 total capital investment level needed to maintain these facilities in a state of good repair is estimated at $151 million.

New Initiatives

The Five Year Capital Program contains three new initiatives in the 1984-1986 period for this category:

- full development of Maintenance of Way's Linden shop complex;
- relocation of Maintenace of Way's Unionport iron shop to a new Bronx site as a result of yard expansion initiatives during this period; and
- construction of five new car washers in yards that store trains overnight but do not contain car maintenance facilities.

Beyond 1986, one new initiative is identified: a program of shop and barn investments in new technology, particularly improved equipment. This program is designed to take advantage of new maintenance techinques and technologies that will improve the efficiency and productivity of the car maintenance operation. This program will also aid maintenance forces in developing the necessary inspection and repair techniques and equipment to cope with new rolling stock that will be acquired during the ten year period. The projected average annual cost of such a program, to begin in 1987, is $3.4 million.

STORAGE YARDS
(Category T-11)

The Transit Authority operates 21 above ground train storage yards. Two of these yards (Linden and 38 Street) are used almost exclusively for the storage of service vehicles. In addition, four major underground locations are used to store revenue trains. Two (137 Street and 174 Street) are officially designated as yards; the other two (Utica Avenue and 179 Street) are not. Yards also house the Authority's subway car shops and barns, and serve as test sites for trains exiting the repair facilities.

Historically, yards have been the target of very little capital investment. The Five Year Capital Program will commit more than five times the amount spent during the prior decade (1972 - 1981) for yards. Prior to the onset of the current program, almost all yards consisted of obsolete -- sometimes original -- equipment long past its useful life expectancy.

The Five Year Capital Program allocates $430 million for yard projects, including six yard expansion projects, the development of Linden Yard, and the rehabilitation of various other yards. Much of the yard rehabilitation work, originally scheduled for the 1984-1986 period, may be deferred to the 1987-1988 period pending a full identification of higher priority track and infrastructure work. The Executive Capital Budget covering the January 1894 - June 1985 period holds nearly $100 million in yard rehabilitation funds in reserve for this purpose.

A total of $579 million is needed over the next ten years to bring all the Authority's yards to a state of good repair. Investment of an additional $80 million will enable initiation of a normal replacement cycle program designed to keep yards in good condition. Finally, a series of new initiatives for yards totalling $265 million ($172 million or 65% of which is included in the remaining three years of the Five Year Capital Program) will result in significant operational and passenger service benefits.

TABLE 20
STORAGE YARDS
10 YEAR CAPTITAL NEEDS, 1984-1993
($ millions)

	1984-88	1989-93	Total
Achieve a State of Good Repair	$231	$348	$579
Normal Replacement Cycle	8	72	80
New Initiatives	172	93	265
Total	$411	$513	$924

State of Good Repair

A general listing -- far from complete -- of the components of yard rehabilitation required to achieve a state of good repair encompasses:

- track rehabilitation, including the replacement of obsolete switches (many of which are hand-thrown), the installation of centrally-controlled snow melters on switches and stop arms, and the replacement of bumping blocks where necessary;
- signal modernization, including upgrading from A.C. to D.C. type relays, tower control of all switches and, at some locations, complete signal rehabilitation;
- power distribution improvements, including the installation of 150-pound contact rail, new contact rail appurtenances and upgraded cables and circuit breakers;
- line equipment modernization, including the rehabilitation of communication, fire and emergency alarm systems, the installation of a talk-back system where required, and improvements to yard lighting; and
- structural rehabilitation of yard support buildings, roadways, walkways and retaining walls, as well as improvements to the existing duct systems and, for elevated yards supported by a deck, rehabilitation of the yard structures themselves.

The projected capital requirements to achieve a state of good repair in all yards by 1993 (including projects scheduled for the remainder of the Five Year Capital Program) are $579 million -- $231 million for the period 1984 to 1988 and $348 million for the period 1989 to 1993.

Normal Replacement Cycle

Initiation of a normal replacement cycle for yard components is necessary in order to avoid wholesale yard rehabilitations and their concomitant disruptions, as is presently necessary. While the expected useful life of various yard components differ, most are relatively long-lived, due to the slow speeds and light loads that prevail in almost all yards. The projected requirements of a normal replacement cycle are based on a useful life of 50 years and consequently amount to an investment of 10% of the value of all yards every five years. It should be noted, however, that the base value

consists only of those yards already in a state of good repair. As more yards are rehabilitated, the expenditure for normal replacement increases.

The projected capital investment required for normal replacement at yards through 1993 is $80 million -- $8 million for the period 1984 to 1988 and $72 million for the period 1989 to 1993. The projected capital requirements for normal replacement beginning in 1994, when all yards will have reached a state of good repair, will be $111 million every five years.

New Initiatives

New yard initiatives during the 1984 - 1988 period will consist of projects already funded under the Five Year Capital Program. These include the completion of yard expansions at the Jamaica and East 180 Street/Unionport Yards, and the provision of additional yard security, in particular at underground yards and storage areas.

A modest program of new initiatives is recommended for the 1989 - 1993 period. The estimated cost of such a program is $93 million, or approximately 18% of the total yard program for that five-year period. This program includes four specific projects.

1. Yard expansion/reconfiguration at 240 Street, Canarsie, and 38 Street:

   While the six yard expansion projects in the Five Year Capital Program will result in the elimination of mainline storage, some undesirable yard conditions will still remain. At 240 Street, only two tracks will be available for cutting and recoupling trains for storage, service and maintenance purposes. At Canarsie, capacity constraints will require storing some Canarsie line trains at East New York, resulting in a deadhead mileage premium. Similarly, inadequate storage capacity at 38 Street will require storing many RR trains at Coney Island. The proposed Canarsie expansion includes the construction of a spur track and minor yard reconfiguration to remedy the existing situation, wherein yard moves interfere with mainline train traffic. A similar problem at 240 Street can be rectified by adding switches to and/or extending the existing yard lead.

B. Development of Linden North

Linden North offers significant opportunities for capital development including: the further consolidation of Maintenance of Way facilities; the construction of a diesel repair shop for the Southern Division; and the provision of general train-storage, either of non-revenue trains relocated from the Westchester Yard or of IRT trains, for which Brooklyn-based storage is in short supply.

C. Construction of a loop track at Pitkin

A loop track circling the yard offers significant operational advantages in the flexibility it affords transportation personnel when making necessary yard moves and when cutting and reassembling trains, both for service and for maintenance purposes. This flexibility is particularly important at a large yard such as Pitkin, currently one of the five largest yards systemwide. In 1970, when a residential building was built over the Pitkin Yard, the building columns were spaced to allow for the eventual construction of a loop track. While construction of a loop track would result in the loss of some yard storage space, the reduction would be mitigated by the fact that most of the storage tracks at Pitkin Yard can hold in excess of a full-length train.

D. Reconfiguration of the Utica Avenue "Yard"

The underground storage facility at Utica Avenue has the physical capacity to store eight trains, but severe operational constraints limit its effective capacity to four trains. As mentioned previously, IRT storage is very scarce in Brooklyn. Reconfiguration of the storage tracks, specifically the conversion of existing stub-ended tracks to double-ended ones by connecting them to existing through-running tracks, could rectify this situation. In addition, the reconfiguration would make the extension of Eastern Parkway express service from Utica Avenue to New Lots Avenue feasible. This would reduce peak running time from New Lots Avenue to Borough Hall by five minutes (18.5%) and make direct Lexington Avenue service available to all New Lots line passengers.

BUS DEPOTS
(Category T-12)

The Transit Authority's bus fleet is stored at 20 depots throughout New York City. Preventive maintenance and minor repairs are performed at these depots, while major repairs are carried out at the two main shops in East New York, Brooklyn and 132nd Street, Manhattan.

Historically, capital investment in bus depots has been very limited. During the ten year period 1972 to 1981, $77 million in capital funds were invested in depots. Fully $70 million of this $77 million was spent during the period 1977 to 1981. Investment levels during the previous five years totaled only $7 million -- an average rate of less than $1.5 million annually.

The Five Year Capital Program increased substantially investment levels for bus depots. Under this program, $432 million is allocated for bus depots during the five year period 1982 to 1986. Part of this allocation was placed in reserve by the MTA Capital Program Review Board. Moreover, the Executive Capital Budget for January 1984 to June 1985 assumes that a portion of the funds originally allocated for depots during this budget period will be redirected to support higher priority infrastructure work. Any deferred projects that were scheduled for the 1982-1986 period are included in this needs assessment, however.

Notably, the average annual allocation for bus depots under the Five Year Capital Program -- roughly $86 million -- is more than ten percent higher than the total $77 million invested during the ten year period 1972 to 1981. Nevertheless, the Five Year Capital Program provides only a portion of the total investment levels required to bring the Authority's bus depots to a state of good repair.

The capital requirements for bus depots are estimated at $591 million over the next ten years -- $380 million for the period 1984 to 1988 and $211 million for the period 1989 to 1993. These needs are summarized below and explained in the following sections.

TABLE 21
BUS DEPOTS
10 YEAR CAPITAL NEEDS, 1984-1993
($ millions)

	1984-88	1989-93	Total
Achieve a State of Good Repair	$328	$99	$427
Normal Replacement	24	90	114
New Initiatives	28	22	50
Total	$380	$211	$591

State of Good Repair

A review of current conditions at bus depots indicates that even given the increased capital investment funded under the Five Year Capital Program, significant deficiencies in depot facilities will still exist by the close of 1986. Most of the bus depots are old and have suffered substantial deterioration as a result of many years of underinvestment. Consequently, an estimated $427 million will be required over the next ten years to bring depots and related equipment to a state of good repair.

About $198 million of these identified capital needs will be required to bring several existing depots to a state of good repair by 1993--specifically Flatbush, Ulmer Park, Queens Village, Fresh Pond, Coliseum, Edgewater, 132nd Street, Kingsbridge, Flushing, 54th Street, and 100th Street depots. Generally, these depots will require either reconstruction or major structural rehabilitation, including new plumbing, heating, and ventilation systems, installation of new equipment, and a variety of other basic improvements. Redesign or reconfiguration to improve internal bus circulation and operating efficiency may also be required. An additional $10 million will be required to fund security and safety improvements at a number of other existing depots.

An estimated $114 million will be required during the 1984 to 1993 period to construct three new bus depots--Gun Hill, Jamaica, and West Side depots. This construction will be necessary to eliminate severe space constraints. Existing depot capacity (particularly in Manhattan) is below that required to adequately house and maintain the bus fleet. Another $71 million will be required to fund new shop repair and warehouse facilities at Gun Hill and Fanchon Place. Finally, $34 million will be required to fund new equipment purchases -- specifically bus washers and bus radios -- and will bring these components to a state of good repair.

This program of investment will bring the bus depots and shops to a state of good repair by 1993. The Authority's ability to attain a state of good repair within a shorter time frame is constrained by the difficult and time-consuming property acquisition process required for prime depot locations, as well as the need to schedule depot rehabilitation projects so as to minimize service interruptions.

Normal Replacement Cycle

Initiation of a normal replacement and reinvestment program for bus depots is necessary to avoid the wholesale depot rehabilitation and concomitant disruptions that are presently necessary. Such replacement and reinvestment would require an ongoing stable investment program to maintain facilities in a state of good repair. Assuming the useful life for bus depots is 40 years, 12.5% of the value of all depots should be reinvested every five years.

The projected capital requirements to establish a normal replacement and reinvestment program for depots and related equipment are $114 million--$24 million for the period 1984 to 1988 and $90 million for the period 1989 to 1993. In the long run, after all depots achieve a state of good repair, the ongoing program should provide $100 million every five years for replacement and reinvestment in bus depots and equipment.

New Initiatives

New program initiatives for bus depots will be limited during the 1984 to 1993 period. The most significant initiative is the potential installation of automatic bus diagnostic systems at all operating bus depots. Automatic bus diagnostics is a computerized tool for the detection and isolation of faults in buses and their subsystems. An automatic bus diagnostic system is currently being installed at the Queens Village Depot. This system will undergo a one year test period and, if successful, bus diagnostics will be installed systemwide. The capital cost of providing such systems in all depots will total an estimated $33 million over the ten year period.

A second program initiative could entail the installation of automatic vehicle monitoring systems throughout all bus depots. An automatic bus locator system is currently used on the Queens Village bus fleet. Additional systems are being installed in the Staten Island depots where the technology will be tested for reliability, performance, and effectiveness. These automatic monitoring systems offer the potential to improve service through centralized control of buses. Locator systems enable centrally located dispatchers to give instructions to drivers in order to avoid bus bunching and to improve schedule adherence. Assuming the test at the Staten Island depots proves favorable, the installation of these monitoring systems in all bus depots will require $5 million during the ten year period 1984-1993.

Another $12 million is provided under new initiatives for the purchase and installation of new technologies yet to be identified. Such technologies would be directed at improving the efficiency and productivity of depot operations.

SERVICE VEHICLES and EQUIPMENT
(Category T-13)

The Authority operates a fleet of over 850 vehicles which support both Surface and Rapid Transit operations. Of these, approximately 400 support the capital construction, maintenance, and repair needs of the right of way (work trains), while the remaining 450 vehicles are road (rubber tire) vehicles.

During the ten year period 1972 to 1981, the Authority committed $42 million for the procurement of various service vehicles. The Five Year Capital Program identifies $64 million for service vehicles. The commitment of these funds will bring the service vehicle fleet to a state of good repair by 1986 and begin a normal replacement and procurement cycle. A portion of these funds, $3 million, has been identified as a new initiative in 1984 for the purchase of track vacuum equipment which will clear refuse from the tracks in subway tunnels. It is anticipated that the normal replacement needs of the service vehicle fleet during the seven year period 1987 to 1993, will be $53 million.

In addition to the funds allocated for the service vehicle fleet, the Five Year Capital Program allocates $7 million for the purchase of shop equipment and machinery, $4 million of which remains to be committed during the 1984-1986 period. It is anticipated that the Authority will need $14 million during the 1987 through 1993 period for the continuing normal replacement of maintenance equipment and shop tools in the 15 car maintenance facilities, 22 surface maintenance facilities and over three dozen maintenance of way shops. This funding level will continue the shop equipment replacement and modernization effort begun in 1982 at the start of the Five Year Capital Program.

TABLE 22
SERVICE VEHICLES AND EQUIPMENT
10 YEAR CAPITAL NEEDS, 1984-1993
($ millions)

	1984-88	1989-93	Total
Achieve a State of Good Repair	$ 9	$-0-	$ 9
Normal Replacement	25	42	67
New Initiatives	3	-0-	3
Total	$37	$ 42	$79

NEW ROUTES
(Category T-15)

The original New Routes program, as conceived in the late 1960's, was to add approximately 40 new route miles to the Authority's rapid transit system, including the Second Avenue subway line in Manhattan, the 63 Street line in Manhattan, and the Archer Avenue line in Queens. The fiscal crisis in the mid-1970's forced the suspension of construction on the Second Avenue line in Manhattan, which by then had begun at four separate locations. While work continued on the 63 Street and Archer Avenue lines in Manhattan and Queens respectively, ballooning construction costs and the increasing capital needs of the existing system necessitated postponing plans to build a central Queens bypass line to connect the two, and a Southeast Queens extension of the Archer Avenue segment.

In 1980, the MTA commissioned a study by Booz, Allen & Hamilton, Inc. to consider various options for utilizing the 63 Street and Archer Avenue lines, in anticipation of their completion in 1985 and 1986 respectively. The study considered more than a dozen options, narrowing them down to five. Among the alternatives still under consideration are the original Queens bypass line (but not the Southeast Queens extension) and a no-build alternative that would not entail any additional construction beyond 1986.

The MTA Planning Department is currently chairing the Queens Subway Options Study (which includes extensive participation by Queens communities) to evaluate each of the five alternatives. The eventual selection of an alternative will be made by the MTA Board after release of the study findings in mid-1984. With the exception of the no-build alternative, each of the options calls for additional construction to begin no sooner than mid-1986 and to last for five to eight years.

The Five New Routes Alternatives

No Additional Construction

Under this alternative, the 63 Street and Archer Avenue lines would be opened for service when completed, and no additional construction would be undertaken to increase their utilization or quality of service. This option requires no additional capital investment beyond that contained in the first two years of the Five Year Capital Program, as service and rolling stock requirements of the two new segments are already factored into the 1987 Car Allocation Plan.

Queens Boulevard Local Connection

Under this scheme, additional construction would be limited to connecting the 63 Street line with the local tracks of the Queens Boulevard line. In order to accommodate 63 Street trains on the Queens Boulevard local tracks, Crosstown line GG trains would terminate at Court Square and a free transfer passageway would be built between that station and the nearby 23 Street-Ely Avenue station on the 53 Street tunnel line.

Queens Bypass

This option represents the original new routes design, and calls for construction of a two-track "super express" line to connect the 63 Street line with the Queens Boulevard line at a rebuilt 71 Avenue station. This connection would follow the Long Island Railroad mainline right of way.

Montauk Transfer

Under this proposal, the 63 Street line would be extended to Thompson Avenue in the Sunnyside yard, where a new station would be constructed to provide an intermodal transfer with expanded Long Island Railroad (LIRR) Montauk branch service -- currently limited to two passenger trains in each direction daily. As part of this alternative, the Montauk branch would be electrified from Jamaica to Sunnyside and all its grade crossings would be eliminated. In addition, several LIRR stations in Queens would be reconstructed.

The viability of this alternative depends in part on the feasibility of coordinating additional LIRR passenger service with existing freight operations on the Montauk branch. Another important consideration is the fare structure that would be instituted on the new LIRR service, which would likely begin at or near the Queens-Nassau border.

Montauk Rapid

This option entails a direct subway connection between the 63 Street line and the Montauk branch via the Sunnyside yard. A second connection would be built at 121 Street to feed Montauk branch subway trains onto the Jamaica elevated line and thereby onto the Archer Avenue line. The Montauk branch would be improved as in the Montauk Transfer option, new stations would be built at Fresh Pond Road and Woodhaven Boulevard, and the existing Richmond Hill LIRR station would be reconstructed.

Like the Montauk Transfer option, this alternative raises the issue of coordinating new passenger service operations with existing freight movements. This issue is compounded by the likelihood that Montauk branch subway service would run at much shorter headways than would LIRR trains, and by the fact that the Authority and the LIRR would be sharing the same right of way for different (passengers vs. freight) purposes. The maintenance of freight operations may require suspending subway service after a certain hour every night.

Capital Needs Assessment

Estimates of capital costs for each of the five construction alternatives are given in Table 23 below. None of these estimates are included in any of the aggregate estimates of financing needs in this assessment. These estimates are based on the costs estimated by Booz, Allen & Hamilton, Inc. in 1980. All costs include new routes construction, necessary construction or expansion of ancillary facilities such as yards and barns, and the purchase of required additional rolling stock.

TABLE 23
ESTIMATED COSTS OF NEW ROUTES OPTIONS 1984 - 1993
($ millions)

Alternatives	Estimated Cost
A. No Additional Construction	$ 0
B. Local Connection	150
C. Queens Bypass	925
D. Montauk Transfer	575
E. Montauk Rapid	525

Since the choice among construction alternatives has yet to be made, it is impossible to accurately project the capital requirements of new routes construction for the 1984 - 1993 period. The Montauk Transfer alternative entails additional uncertainty, since a potentially sizable portion -- as yet undetermined -- of its capital cost would be incurred by the Long Island Railroad, and not by the Transit Authority. Finally, the wide range of estimated costs across options renders average or median cost estimates meaningless.

OTHER PROGRAMS
(Included in Category T-16)

Procurement and Distribution

The Procurement and Distribution Department is responsible for the purchasing, inspection, storage, and distribution of all parts and material used by the Authority. The Authority operates 11 major storage and distribution facilities and various other "satellite" storerooms at each of the car and bus maintenance and repair facilities. It is anticipated that $20 million in capital funds will be necessary during the 1984-1993 period to support the modernization and normal replacement needs of facilities and equipment for the Procurement and Distribution Department.

Systems and Information Management

The Systems and Information Management Department is responsible for gathering, processing, and reporting on the vast quantity of information regarding the operations of the Authority. The department is also responsible for developing and maintaining all the necessary hardware and software to support the information systems of the Authority. Prior to 1982 and the initiation of the Five Year Capital Program, the Authority's information systems were inadequate and burdensome.

The Five Year Capital Program allocates $76 million during the 1982-1986 period to support the efforts of the Systems and Information Management Department. Approximately $50 million remains to be committed during the 1984-1986 period. It is anticipated that during the 1987-1993 period, $53 million will be needed for the normal replacement needs as well as the continued development and enhancement of the Authority's information systems, resulting in total capital needs of $103 million over the 1984 to 1993 period.

New Technology Investigation and Testing

The primary focus of the Five Year Capital Program is to bring to a state of good repair as many components of the transit system as possible within certain financial and operational constraints. The identification of capital funding needs through 1993 is focused on achieving a state of good repair and on creating a normal level of capital reinvestment and replacement for each system component. In an effort to complement the goals of good repair and normal replacement, $25 million has been identified for special design and engineering projects that will focus on the investigation, testing, and implementation of new technology. These projects will focus, in particular, on new inititatives which may improve the efficiency and productivity of the Authority operations.

Emergency, Contingency, and Miscellaneous

Funds are reserved for emergencies and contingencies that may develop in the future. During the 1984-1986 period, $119 million has already been allocated for emergencies, contingencies, and miscellaneous minor projects. During the 1987-1993 period, an additional $443 million will be reserved for these purposes. This level would provide emergency and contingency funds equal to five percent of the total value of capital investments over the ten year period.

STATEN ISLAND RAPID TRANSIT

The Staten Island Rapid Transit Operating Authority (SIRTOA) operates along a two track line, 14.5 miles long. SIRTOA serves approximately six million passengers annually at 22 stations. Nearly 85% of SIRTOA's riders use the system to commute to the Staten Island Ferry. Currently, the rush-hour trains are at capacity and demand is expected to increase during the next ten years.

The Five Year Capital Program allocates $34 million for SIRTOA during the 1982-1986 period. The primary focus of the SIRTOA Five Year Capital Program has been on infrastructure rehabilitation, particularly the improvement of the power system. Approximately $4 million of the Five Year Program funds remains to be committed. An estimated $146 million in additional capital funds will be necessary to maintain and improve the SIRTOA system during the 1987-1993 period, for a ten year total of $150 million. There are three primary areas that will require substantial capital investment during the ten year period.

Stations

Most of SIRTOA's station platforms were built during the 1930's. They are generally small, uncomfortable, poorly lit and unsafe. The platforms require lengthening and overall rehabilitation. The average per station cost of this work is estimated at less than $1 million. Eight additional stations will require rehabilitation during the 1987-1993 period at a total cost of $4 million. It is also anticipated that the St. George terminal station will require extensive modernization during the 1987-1988 period, at an estimated cost of $5 million. These expenditures will bring SIRTOA passenger stations to a state of good repair by the end of the ten year period.

Two new initiatives in stations will be undertaken during the ten year period 1984 to 1993. Automatic fare collection equipment will be installed on the SIRTOA system at a cost of more than $2 million. Additionally, $2 million has been identified for SIRTOA to fund a special program designed to attract automobile riders by constructing parking lots in key locations along the rapid transit route.

New Cars

SIRTOA's current fleet of 54 R44 subway cars are sufficient under present conditions. Given the anticipated increases in ridership and the scheduled improvements to the power system, however, additional cars will be needed. It is anticipated that 10 new cars will be needed in 1988. The estimated cost of these cars is $13 million.

Track and Signals

Much of SIRTOA's track and signal equipment is outdated and in need of repair. To replace all deteriorated rail, additional capital commitments of $93 million are needed. In addition, a complete modernization of the SIRTOA signal system would cost more than $4 million per mile for a total estimated cost of $130 million. While these identified needs total $233 million, practical scheduling limitations and competing priorities limit the level of work that can be performed on SIRTOA during the 1984-1993 period. It is anticipated that 14 miles of both the signal and track systems can be brought to a state of good repair by 1993 at a cost of $109 million. A continuation of this program would bring the remaining track and signal work to a state of good repair by 2000.

Finally, $10 million has been identified for new inititatives on the SIRTOA system. This funding will enable completion of the second phase of the crossover and reverse signalling project initiated during the Five Year Capital Program.

APPENDIX A

Appendix A

10 YEAR CAPITAL NEEDS 1984-1993
UNDER ALTERNATIVE INFLATION ASSUMPTIONS
($ millions)

	1984-88	1989-93	Total
Achieve a State of Good Repair			
-1984 Constant Dollars	$ 4,299	$ 2,968	$7,267
-5% Inflation	4,751	4,186	8,937
-7.5% Inflation	4,994	4,950	9,944
-10% Inflation	5,249	5,836	11,085
Normal Replacement			
-1984 Constant Dollars	$ 665	$ 2,756	$3,421
-5% Inflation	735	3,887	4,622
-7.5% Inflation	773	4,596	5,369
-10% Inflation	812	5,420	6,232
New Initiatives			
-1984 Constant Dollars	$ 521	$ 591	$1,112
-5% Inflation	576	834	1,410
-7.5% Inflation	605	986	1,591
-10% Inflation	636	1,162	1,798
Total			
-1984 Constant Dollars	$ 5,485	$ 6,315	$11,800
-5% Inflation	6,062	8,907	14,969
-7.5% Inflation	6,372	10,532	16,904
-10% Inflation	6,697	12,418	19,115

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